SCIENTIFIC AMERICAN

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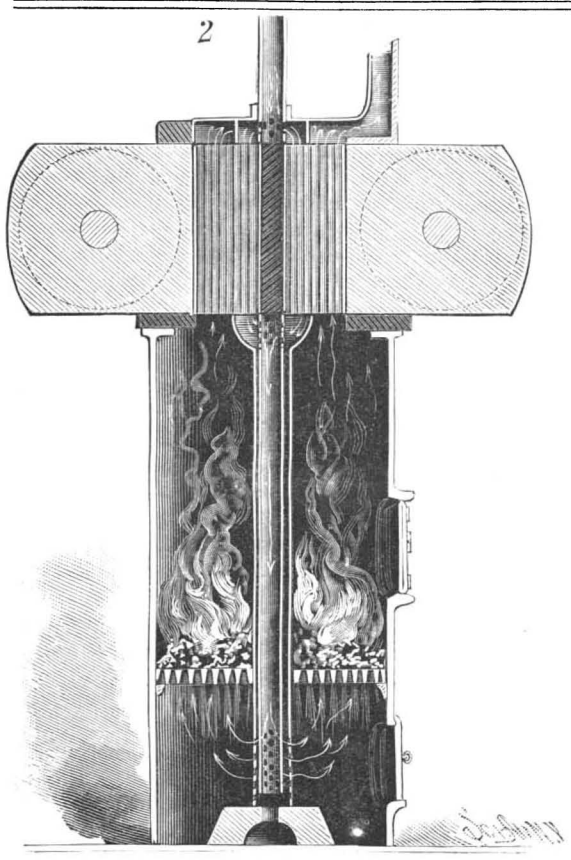
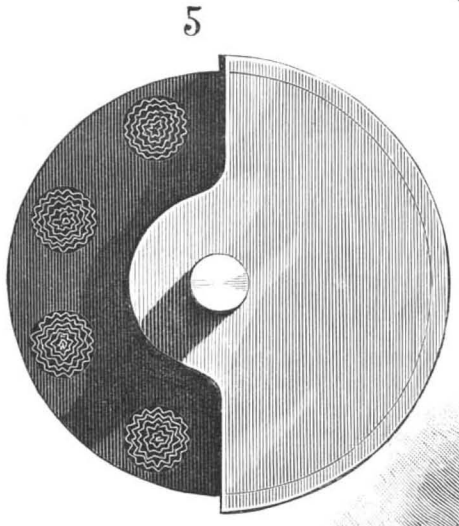
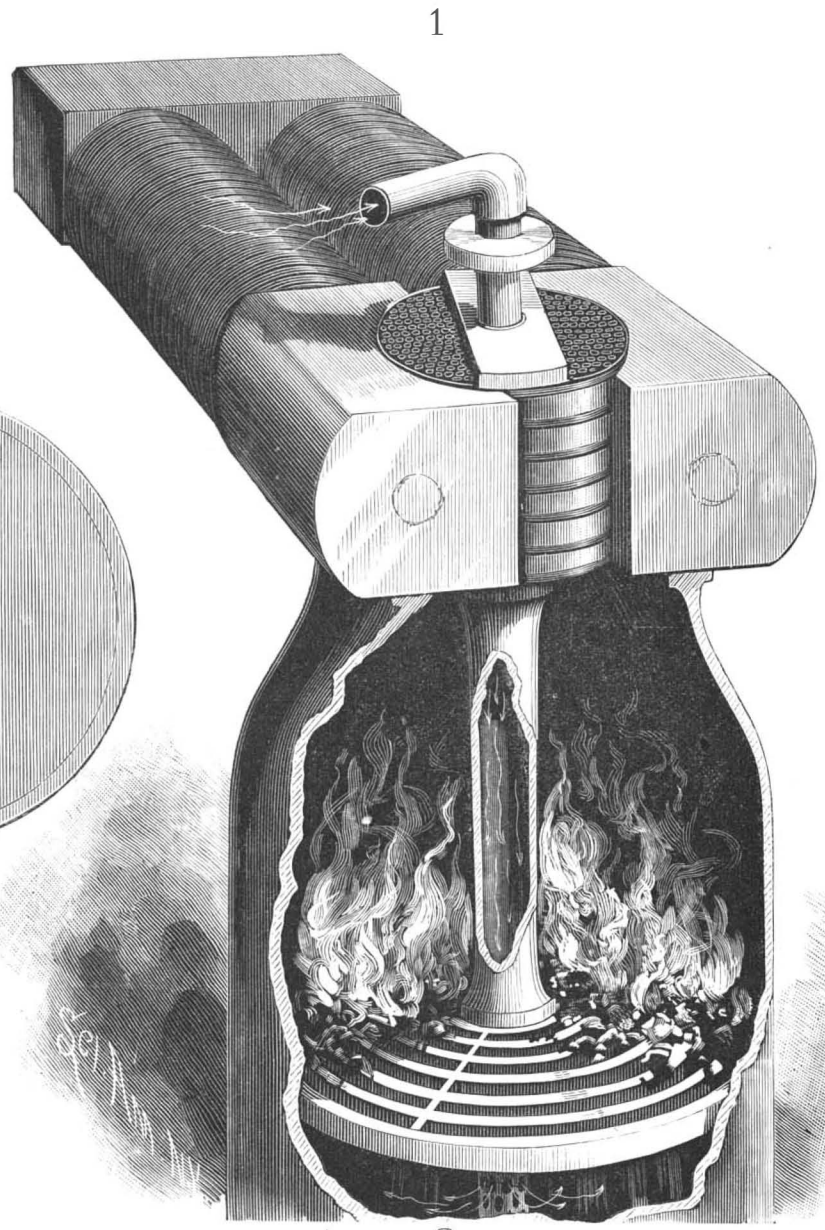
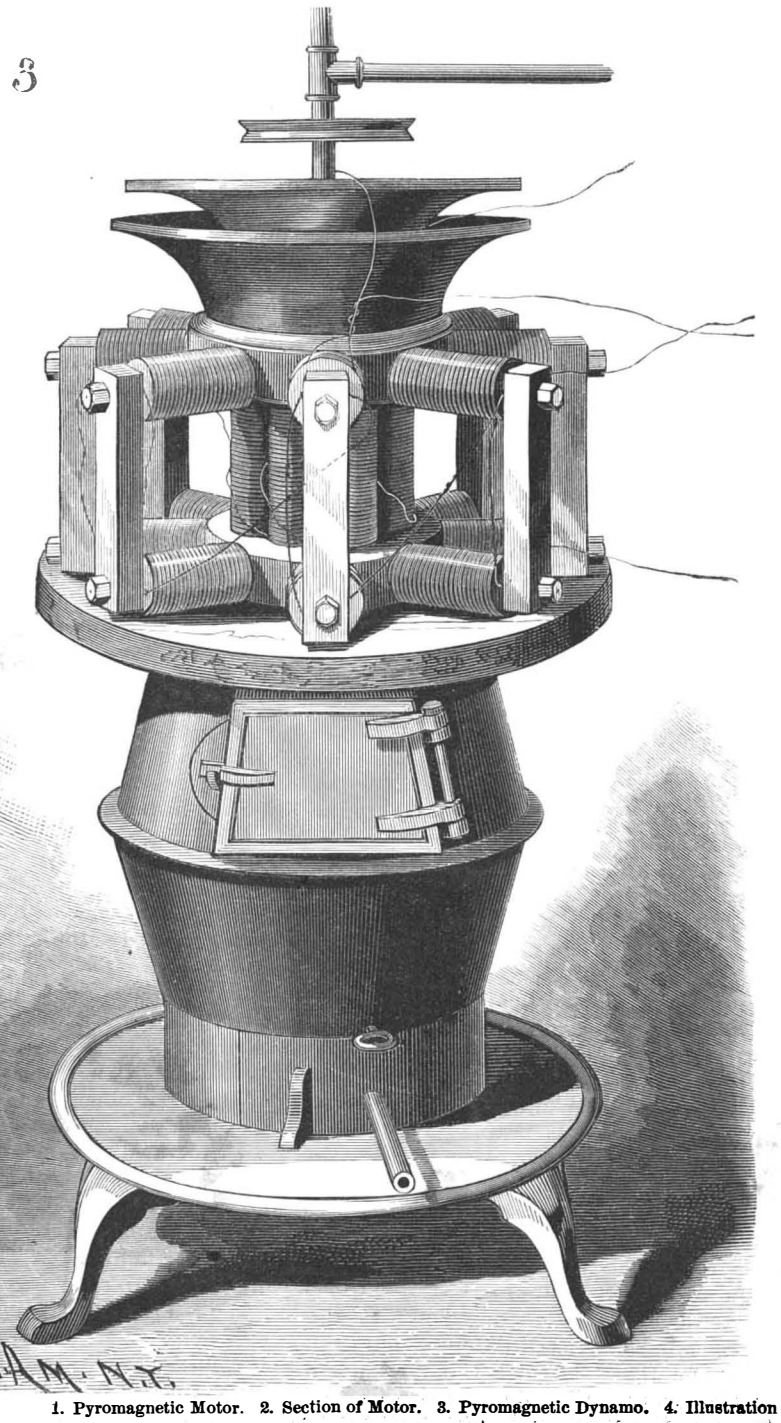
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

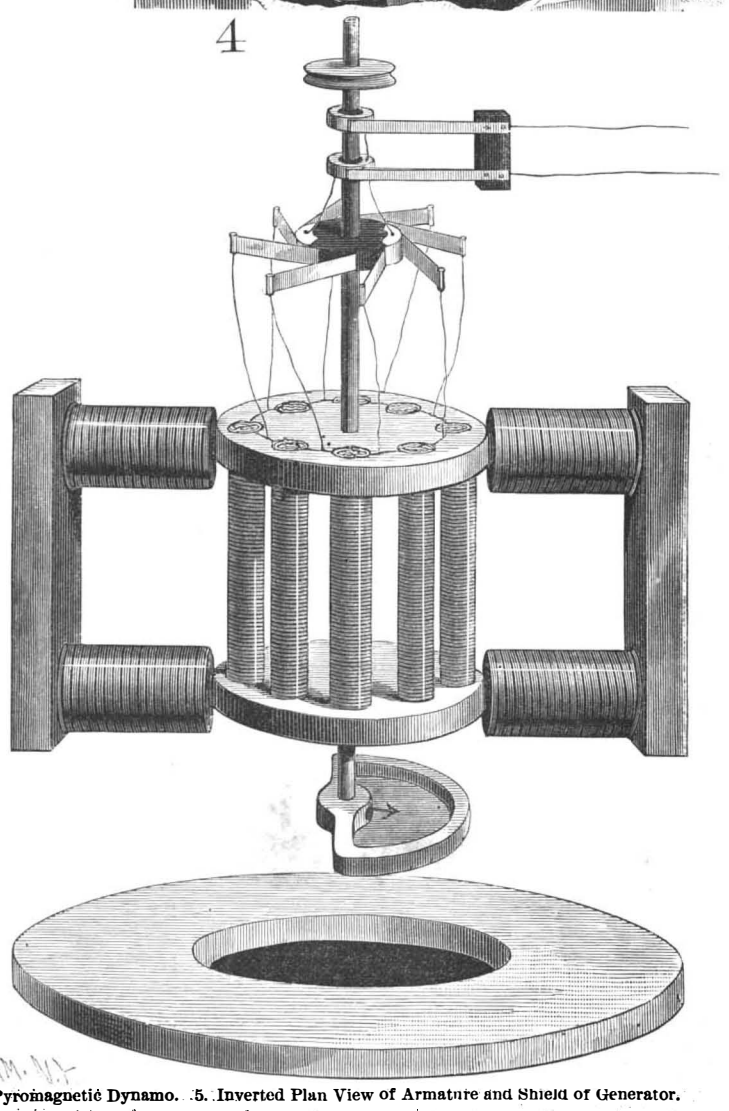
Vol. LVII.—No. 9. [NEW SERIES.] NEW YORK, AUGUST 27, 1887. [$3.00 per Year.











1. Pyromagnetic Motor. 2. Section of Motor. 3. Pyromagnetic Dynamo. 4. Illustration of Details of Pyromagnetic Dynamo. 5. Inverted Plan View of Armature and Shield of Generator.

EDISON'S NEW ELECTRICAL DISCOVERIES—MACHINES FOR OBTAINING ELECTRICITY DIRECT FROM FUEL.—[See page 133.]

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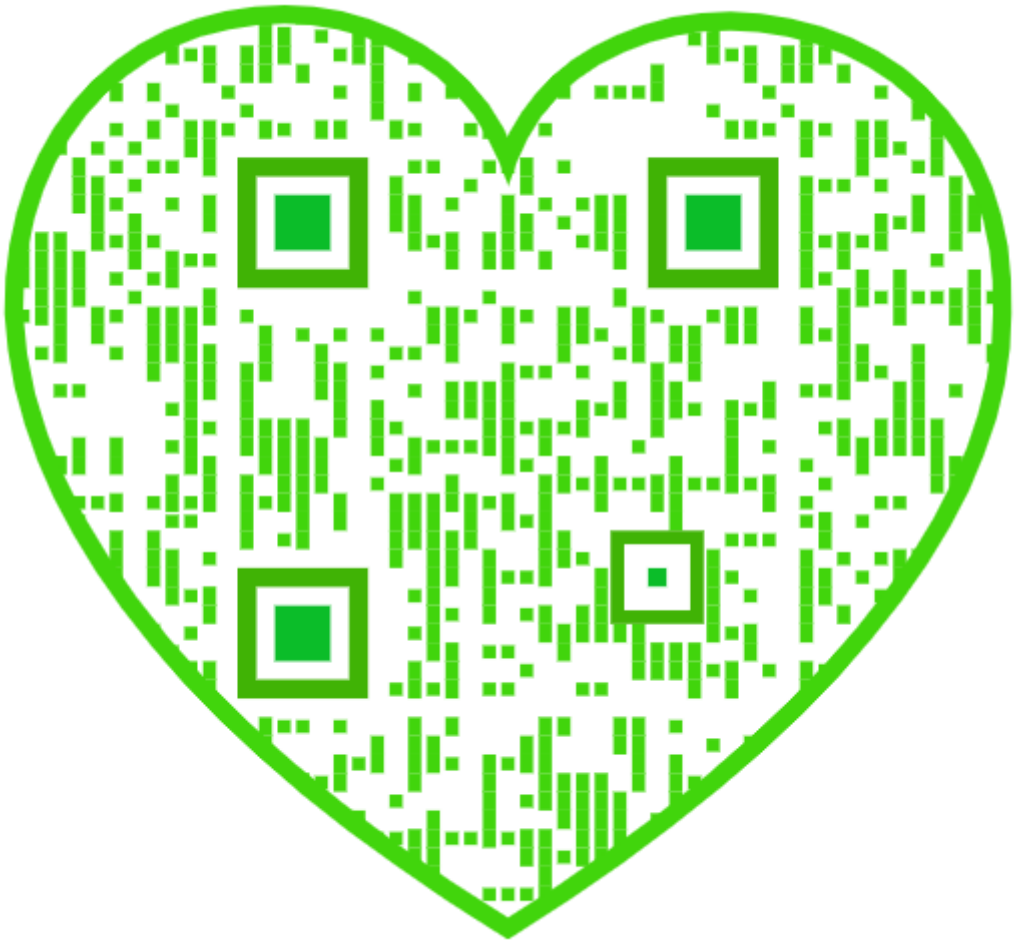

Scientific American.

ESTABLISHED 1845.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, NEW YORK.

O. D. MUNN. A. E. BEACH.

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NEW YORK, SATURDAY, AUGUST 27, 1887.

Contents.

(Illustrated articles are marked with an asterisk.)

Alcohol in high latitudes..... 136
Ant eater, New Guinea*..... 135
Ballooning, high 131
Blot, the, upon our statute books 129
Brake, car, electrical* 132
Bridge, Firth of Forth, principle of*..... 134
Car coupler, improved*..... 130
Cataract operations, revolution in after treatment of..... 132
Churn, improved, Deighton's* .. 130
Collar, horse, improved*..... 131
Cruisers, new, bids for..... 137
Death by electricity..... 137
Electric power service..... 138
Electric street railway, Detroit.. 129
Electrical transmission, velocity of..... 137
Electricity from steel, machine for producing*.....127, 133
Foot rest, improved*..... 130
Gunboats, new, bids for..... 137
Inventions, agricultural..... 139
Inventions, engineering..... 139
Inventions, index of 139
Inventions, miscellaneous..... 139
Level, spirit, the..... 136
Locomotive attachment for removing obstructions from railroad tracks*..... 130
Locomotion, comparative..... 138
Longevity, philosophy of..... 129
Measuring jackets and patterns, combined*..... 131
Microphone and telephone, the names..... 131
Motive force of the world, entire 132
Musical flames*..... 137
Odometer, improved*..... 131
Oil the waves..... 133
Photographic notes..... 129
Planets in September, positions of..... 129
Pump, improved, Dobson's*..... 131
Pyromagnetic dynamo, on the* 127, 133
Sewing machine cover and stool* 130
Science, advancement of..... 128
Screw industry, Berlin..... 137
Smell, sense of, delicacy of..... 130
Spoke cyclometer, improved*... 131
Tannin in boiler incrustation.... 130
Tin cans, square, machine for forming*..... 131
Tunnel, proposed, English Channel 132
Water wheel, Millot-Hauvel*.... 134
Well artesian, at Galveston..... 131
Whale, tattooed* 135
Wheel, hydraulic, Millot's*..... 134

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 608,

For the Week Ending August 27, 1887.

Price 10 cents. For sale by all newsdealers.

PAGE

I. ASTRONOMY.—Harvard's New Observatory.—The new observatory in Colorado, the outcome of the Boyden bequest to Harvard College..... 9715

II. BIOGRAPHY.—Milton Josiah Roberts, M.D.—By J. J. SULLIVAN, M.D.—The life and portait of Professor Roberts, Professor of orthopedic surgery and mechanical therapeutics at the New York Post-Graduate Medical College.—1 illustration..... 9714

III. BIOLOGY.—What American Zoologists have done for Evolution.—By Professor EDWARD S. MORSE.—Continuation of this exhaustive paper..... 9712

IV. BOTANY.—The Annatto Bush.—The famous dye plant, its cultivation and habits, and the preparation of the pigment..... 9717
The Giant Arbor Tree.—A great Arbor vitæ, the *Thuja gigantea*; its uses and availability as a foliage tree..... 9717

V. CHEMISTRY.—Germanium.—Very full account of this new element, its properties and analogies..... 9713
A Delicate Test for Bismuth.—A reaction showing one part in one million of a solution of the metal..... 9718

VI. ELECTRICITY.—How to Make a Leyden Jar.—Hints on the materials and construction of this form of condenser..... 9707
On a New Method of Measuring Magnetic Susceptibility and Magnetic Permeability.—By THOMAS T. P. BRUCE WARREN.—An interesting investigation into the magnetic qualities of the non-magnetic metals..... 9709
The Use of the Magnetic Needle in Exploring for Iron Ore.—By Mr. BENNETT H. BROUGH.—A review of the various methods of magnetic exploration for ore..... 9708

VII. ENGINEERING.—Carrying Water Mains across a River.—Interesting description of a new method of carrying out this operation..... 9706
Track Laying by Steam.—An interesting invention in railroad construction.—1 illustration..... 9707

VIII. GEOLOGY AND GEOGRAPHY.—Geology and Geography.—Abstract of the more important papers read in Section E of the A. A. A. S. at the Columbia College meeting..... 9711
Caverns near Manitou, Colorado.—2 illustrations..... 9710

IX. MEDICINE.—A New Local Anæsthetic.—By J. HERBERT CLAIBORNE, Jr., M.D.—Stenocarpin, the new alkaloid.—Its discovery and properties.—A rival of cocaine..... 9714

X. MISCELLANEOUS.—The Taking of the Bastile.—An interesting mathematical game or puzzle, with its solution.—3 illustrations..... 9716

XI. NAVAL ENGINEERING.—A Reaction Propeller.—A new system of propulsion described, with the fatal accident in experimenting with it.—3 illustrations..... 9703
Improved Collapsible Boat.—An important addition to life-saving apparatus.—5 illustrations..... 9706
The Brennan Torpedo.—A "controlled" torpedo driven by direct mechanical connection, adopted by the British Government.—6 illustrations..... 9704

XII. PHOTOGRAPHY.—Photography by Vital Phosphorescence.—By D. JNO. VANSANT.—Printing from a negative by the light of fire-flies..... 9709

XIII. PHYSICS.—Freezing Mixtures.—Tables of mixtures and liquids of low boiling points adapted for freezing..... 9710
Physics Without Apparatus.—Two amusing experiments from *La Nature*.—2 illustrations..... 9717
Soap Bubbles.—How to affix a paper aeronaut to a soap bubble.—2 illustrations..... 9716
The Principle of Inertia.—Two experiments of the same class described.—2 illustrations..... 9716

ADVANCEMENT OF SCIENCE.

The American Association, whose meeting at Columbia College has commanded attention, even in a busy city like New York, adjourned on the 16th inst., after a week of really hard work, some of whose results we now lay before the reader. There were enrolled 721 members present, of whom 321 were new—the largest meeting for several years, with the single exception of that at Philadelphia, when the number was swelled by accessions from the British Association. There were in all 272 papers offered to the council, of which 256 were actually read in the various sections, many of them being also made the subject of additional discussion. Aside from official addresses and the routine business, the only scientific address in the general sessions of the association was by Prof. Henry Drummond, of Glasgow, on "The Heart of Africa." The association is subdivided into eight sections, each of which represents one or more branches of science, and usually all were simultaneously in session. This plan, while open to some objections, makes it possible to go over a great deal of ground in a week, and the winnowed results are finally made accessible to all the members by being distributed in a bound volume. Yet the question arises if there ought not, at every annual meeting, to be a larger number of evening addresses in general session by eminent men of science on practical matters of universal interest. We cannot refrain from another suggestion, namely, that those who read or speak in public should give enough attention to the art of speech to make themselves heard. Many of the most valuable papers were marred by indistinct utterance, misplaced emphasis, and false inflections.

We visited all the rooms set apart for the several sections, and were impressed by the vast variety of topics discussed. Some of the papers read bristled with technicalities. It would, perhaps, be difficult to report, in a way to interest the general reader, the paper on "The Amine Salts of Paratoluenesulphonic Acid," or another on a "Critical Revision of the Monticuliporoid Corals of Cincinnati." Yet some papers with formidable titles were made attractive after all by the clear style of the authors.

One paper, by Prof. W. O. Atwater, on the "Physiological and Pecuniary Economy of Food," called for nearly a whole day's discussion. He said, in substance, that the cheapest food is what furnishes nutrition at the least cost; while the most economical food is what is both cheapest and best adapted to the wants of the user. Vegetable foods are, as a rule, less costly than animal foods, but not so richly nutritive. Flour is cheaper than potatoes, because the protein in the latter is inferior and less digestible. The worst form of American wastefulness is the waste of beef, lamb, veal, fish, flour, and potatoes, fruit, and other kinds of food, and this is chargeable both on the rich and the poor. People buy more than is needed, and eat more than can be digested. Much of the excess is actually thrown away. Costly materials are used where less expensive ones would do as well. False economy is practiced in buying what seems to be cheap, but is really dear. Add to this the evils of wrong selection in marketing, careless keeping, bad cooking, and unskillful using in the home, and it will be seen that the financial loss is very great. The physiological waste is still greater. More harm is done by unwise eating and drinking than can be estimated. The rich suffer both in health and in purse, but the poor suffer most of all. The food of the wage classes is large in amount and costly in kind. The German standard calls for 118 grains of nutritive ingredients *per diem*, whereas the American workingman consumes from 95 to 254 grains. But, on the other hand, the latter can do more work, and his superior capacity is largely due to his better nourishment. What ought to be the panurgy of the average American laborer, with his great opportunities, superior intelligence, and the 6,776 foot-tons of potential energy in his daily food?

A paper that aroused much enthusiasm in the section of physics was by Drs. Michelson and Morley, on a "Method for Making the Wave Length of Sodium Light the Actual and Practical Standard of Length." It was claimed that no natural standard had ever been found that would prove unvarying, except this one. This standard was obtained by sliding a reflecting mirror through a measured space, and counting the number of interference fringes produced by the motion, indicating the number of wave lengths, and taking this length as the unit of measurement. Temperature variations were prevented by incasing the apparatus in melting ice. Among approving remarks was that made by Professor W. A. Rogers, who has devoted much time to exact measurements, that this novel idea "went to the bottom of his heart." It was proposed to produce, as soon as possible, a standard unit of length, to be styled the "American Association unit," and a note was taken, asking the A. A. A. S. to appropriate money in order to continue the investigation.

As a matter of course, the paper by T. A. Edison (read by Professor G. F. Barker), on the "Pyromagnetic Dynamo: a Machine for Producing Electricity from Fuel," elicited much interest, as the problem is one that has occupied the closest attention of the ablest inventors for many years. If the enormous energy latent in coal could only be made to appear as electric energy by some simple means, and at a reasonably economical rate, it would certainly revolutionize the mechanical methods of the entire world. This fact has marvelously stimulated research as to thermo-electricity; the most satisfactory results thus far being gained by Moses G. Farmer. He never succeeded, however, in converting one per cent of the energy of the coal into electric energy. Lord Rayleigh's recent experiments have led him to conclude that, from a thermo battery of copper and iron working between the extreme limits of temperature possible under these methods, not more than one three-hundredth of the energy in the coal can be converted. Edison's opinion therefore is that the result sought must be attained by other means. He suggests that the magnetism of the magnetic metals is strongly affected by heat; nickel losing its power at 400°, iron at a cherry red heat, and cobalt at a white heat. By placing an iron core in a magnetic circuit, and varying its magnetizability by varying its temperature, a current can be generated in a surrounding coil of wire. This he calls a "pyromagnetic generator of electricity," and he has constructed a small motor upon this principle, the details of which were explained to the section, and are illustrated on our first page.

These experiments seem to promise a solution of the problem of the economical production of electricity direct from fuel.

The whole of one afternoon was devoted by the sections of engineering and economic science in joint session to the discussion of the Nicaragua Canal. Elaborate and interesting papers on the subject were presented by Commander H. T. Taylor, Engineer R. E. Peavy, Surgeon John F. Bransford, U. S. N., and J. W. Miller, General Manager of the Boston and Stonington Line. Both the Tehuantepec and Panama schemes promise to be failures, while the Nicaragua Canal is certain of success. With regard to this canal, the public is not asked to take anything on the strength of simple assertion, but it has all the means of arriving at certain results placed fully, clearly, and without reservation before it, in such a way that every one can form an independent judgment about it. The papers discussed the climatic and sanitary conditions along the proposed route, showing that while the line of the canal from the coast would lie for some ten miles through swamps where the work would have to be done by machinery and the natives, the beauty, fertility, and salubrity of the Pacific slope beyond are unsurpassed. The length of the canal from ocean to ocean will be 169·8 miles, of which only 40·3 miles is actual canal, the remainder being free water route through Lake Nicaragua. The advantages of this lake as a great harbor are of immense importance. The undeveloped water power of the lake will be very great and under perfect control for commercial and manufacturing purposes.

Concerning the "Strength of Nicaraguan Woods," a special paper was read by Prof. R. H. Thurston, of Cornell University, describing investigations made recently by Mr. Rufus Flint to secure data that may lead to the introduction of the woods of his country into the markets of the world. Some resemble mahogany, others the yellow pines, oaks, and other hardwoods of our own forests, but excelling them in density, strength, elasticity, and durability.

The "Increase of Blindness in the United States" was the subject treated of by Prof. Lucien Howe. While the population of the country increased 30 per cent between 1870 and 1880, blindness increased 140 per cent, and now it costs more than $25,000,000 annually to support our blind.

Mr. Geo. F. Kunz, of the house of Tiffany & Co., in this city, described a remarkable crystal skull and also a gigantic jadeite adz from Mexico. He exhibited magnificent specimens of agatized wood from Arizona, polished to the brightest luster and showing the richest imaginable play of colors.

Prof. F. W. Putnam, the faithful secretary of the association, gave a brief description of the famous "serpent mound" of Adams County, Ohio, and its purchase for preservation by the Peabody Museum of Harvard University.

The transactions of the geological section were of special interest and importance, and will be made the subject of a separate article.

No account of this meeting of the association would be complete without at least a reference to the two papers presented on the Chinese in America. The first, by Stewart Culin, an American who has adopted the Chinese religion, and will soon go to the Celestial country to live, and who, in his paper, spoke especially of the social life of the Chinese in the Eastern cities of the United States. The other address, "The Chinese Question from a Chinese Standpoint," was by Mr. Yan Phou Lee, who has adopted the Christian religion, has taken out his first papers for American citizenship, and is a graduate of Yale College. His eloquent appeal for justice to be done to his countrymen, although more oratorical than scientific, was received by a crowded audience with generous applause.

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The next meeting of the association will be at Cleveland, Ohio, in August, 1888. Major J. W. Powell, of Washington, D. C., was chosen as president. There was also the usual election of other officers for the association and for the sections.

POSITIONS OF THE PLANETS IN SEPTEMBER.

VENUS

is evening star until the 21st, and then morning star. On the 21st, at 11 o'clock in the morning, she arrives at inferior conjunction, and, passing between the earth and sun, completes her course as evening star, changing from the eastern side of the sun to the western, and commencing her course as morning star. She sets on the 1st about a quarter before 7 o'clock, a little less than half an hour after sunset. On the 30th, she rises at 20 minutes before 5 o'clock in the morning, an hour before sunrise.

JUPITER

is evening star. He will be the brightest star in the heavens for nearly the whole month, as Venus sets soon after the sun in the early part of the month, and is quickly lost to sight. Jupiter will be found in the west, soon after sunset, in the constellation Virgo, 11° east of Spica on the 1st and 16° east of the star on the 30th. He sets on the 1st a few minutes before half past 8 o'clock in the evening, two hours after sunset. On the 30th he sets at a quarter before 7 o'clock, an hour and a quarter after sunset.

MERCURY

is morning star until the 10th, and then evening star. On the 10th, at 1 o'clock in the afternoon, he is in superior conjunction with the sun, passing beyond the sun and reappearing on his eastern side to run his short course as evening star. He is invisible during the month, rising on the 1st about half past 4 o'clock in the morning, and setting on the 30th about 6 o'clock in the evening.

URANUS

is evening star, is very near the sun, and nearly at his greatest distance from the earth. He sets on the 1st at half past 7 o'clock in the evening, and on the 30th soon after half past 5 o'clock.

SATURN

is morning star. He is an interesting object for observation in the early morning hours, as he moves eastward among the small stars of Cancer, being about 9° southeast of Pollux and about the same distance northeast of Procyon. He rises on the 1st at 2 o'clock in the morning, and on the 30th about a half hour after midnight.

MARS

is morning star. He is still small in size and luster. At the commencement of the month he is about 2° northeast of Saturn, and may be found with the aid of an opera glass. He rises on the 1st soon after 2 o'clock in the morning, and on the 30th at a quarter before 2 o'clock.

NEPTUNE

is morning star, and is nearly at his greatest distance from the sun. He is in the constellation Taurus, south of the Pleiades, rising on the 1st about a quarter before 10 o'clock in the evening, and on the 30th about a quarter before 8 o'clock.

THE BLOT UPON OUR STATUTE BOOKS.

A recent event has directed our attention to the operation of the Chinese immigration laws in a manner that is not particularly flattering to our pride as citizens of the greatest and freest republic in the world. The circumstances, when briefly related, are these: Two tea-carrying steamers, the Monmouthshire and the Glenshiel, started from Amoy nearly the same time, for New York. They raced with each other over a whole hemisphere, with the Glenshiel coming into port several days ahead, having made the trip in forty-two days and thirteen hours—the fastest time on record.

It seems that the crew of the Glenshiel consisted of Chinamen. As soon as she arrived, an inspector of customs was placed in charge of the vessel, "in order," as one daily paper stated, "to prevent any of them landing to degrade American labor."

Now, observe that the men thus watched and guarded by the argus-eyed inspector of customs were not criminals, nor paupers, nor even workmen competing with Americans in the labor market, but simply sailors who desired to recreate on land after the toil and hardships of a long ocean voyage. To forbid the landing of sailors ordinarily would be the refinement of cruelty; but in the present case it was an exhibition of barbarism hardly to be expected from the most enlightened nation on the globe.

Imagine the feelings of those gallant and plucky seamen on being told that they were forbidden to land, lest they degraded American labor! that America, free to the rest of the world, including the wild men of Borneo and the degenerate Hottentots, was not free to them, simply because they were Chinese, and that they must content themselves with a sight of the land flowing with milk and honey, but were not to enter it. Imagine their disappointment and their disgust with the loud pretensions of this country to be a land of refuge! What must they have thought of the mockery of Bedloe's Island—Liberty enlightening the world? The irony of the French sculptor is not the less keen because unintentional.

Suppose our American sailors, the bravest and pluckiest of all that plow the high seas, were forbidden by Chinese law to land on the Chinese coast! How indignant we would be, and how eloquently we would declaim on Chinese heathenism and exclusiveness! And yet, under our very noses, the laws against Chinese immigration are so enforced as to perpetrate the grossest injustice and inhumanity.

Every day we meet with cases where the mischievous operation of the anti-Chinese laws can be plainly seen. But while we can trace many evils directly to the enforcement of these laws, the evils that result indirectly are neither to be traced nor to be adequately calculated. The persecution, distress, and wrongs to which the Chinese in this country are subject in consequence of those laws and their harsh execution are unknown quantities; but it does not require much intelligence for any one to understand that when our government refuses to acknowledge the rights of these poor strangers, and shows itself reluctant even to accord them the protection of the laws, this will be taken advantage of by their mortal enemies, the foreign miner, the sandlotter, the hoodlum, and the saloon politician. We quote the following from *Fire and Water*, to show that we are not talking at random:

"When calling attention last week to the danger of a destructive conflagration at Los Angeles, Cal., we might have added to the other hazards that contributed by the presence of a large and extremely unpopular Chinese element. It seems that barely a fortnight ago the agents of most of the insurance companies canceled their policies on buildings occupied by Chinamen, upon the ground that the existing feeling against them made the hazard too great. They have reason to congratulate themselves upon their foresight, for early on last Sunday morning a fire of unknown origin, which started in a gambling den in the Chinese quarter, consumed twenty-five buildings, in which about 1,000 of the "almond-eyed" had been housed, the losses being estimated at $100,000; and the press dispatches mention significantly that, although the fire companies came promptly to the spot, the slow and deliberate way in which they went to work 'seemed to indicate that they were not over-anxious to save the buildings.'"

It is true that the fire started in a gambling den, but the majority of those who were burned out of house and home were, doubtless, industrious and peaceable men—not addicted to gambling. Could there be a meaner exhibition of depravity than that shown by those firemen? They did not put out the fire, but they extinguished every spark of honor and humanity in their own breasts.

As Americans, we are ashamed to own that such things are possible within our boundaries. We are not proud of the position we occupy of being the only nation that carries out a policy of exclusion, and we denounce the ill-treatment of the Chinese as unchristian, barbarous, and inhuman.

Philosophy of Longevity.

There is much in modern life that tends to shorten existence and to diminish the probability that a man or woman will reach ninety, to say nothing of a hundred. We lead more exciting and more wearing lives. It is in vain that a person has a splendid constitution to begin with, wears flannel, or the equivalent of flannel, next to his skin, dwells in a warm, dry house, and eats and drinks everything that is good and wholesome, if at the same time he habitually overtaxes his strength, looks upon his muscles as mere machinery to be driven at high pressure, and ruthlessly calls upon his nerves to squander their reserve power when every other source of energy is exhausted. Men or women who intend to be centenarians in these days must combine something of the old mode of life with something of the new mode of living. They must, while availing themselves of all the scientific discoveries and sanitary appliances of the age, imitate their grandsires in the steady and tranquil habits that prevailed before the invention of locomotives and the telegraph. They must have their eight hours of sleep regularly; they must have intervals of repose and vacancy in the daytime; they must spend a goodly portion of their waking hours in the open air. Nor will that suffice; there will have to be regularity in the hours of their meals, and discipline in the ordering of the dishes of which the meals are composed. We cannot believe that anybody will ever live to one hundred who eats a heavy dinner every night of his life at eight o'clock. Champagne in abundance, and Bordeaux or Burgundy *ad libitum*, should be forsworn by persons who deliberately set before them the attaining of their hundredth birthday. Neither, with such an end in view, would the active life of a politician, a lawyer, or a doctor be a same enterprise. In order to reach that distant goal there must be a training, if not severe, at least regular and unflinching. Most of all there must prevail in the existence of such a person a tranquil serenity, an unruffled calm. Neither generous passions nor enthusiastic ideals must be allowed admittance. The pulse must never be driven up beyond a certain point, either by work, by anxiety, by fear, or by hope. At the same time, mere stagnation will, in all probability, never enable a person to live to one hundred. There is such a thing as rusting out as well as wearing out. If a candle does not burn brightly enough, it does not consume the wax with rapidity, and goes out for want of adequate combustion. It is so, no doubt, with the human body and the human spirit.—*London Standard.*

PHOTOGRAPHIC NOTES.

Reproductions on Erythrosine Bathed Plates.—The most favorable illumination for oil paintings is a direct front light, by which shadows cast from very thick strata of paint and strong brush marks are considerably allayed, and the structure of the canvas is made invisible.

Black or neutral colored screens, placed at certain angles toward the object to be copied, will absorb the objectionable light, and leave the original free from reflections. Gloss and flares may cause disturbances; but these may be overcome by placing reflecting mirrors behind the lamps, and by adjusting one horizontally directly under the picture.

When very old oil paintings have hung for a long time, exposed and subjected to dust, moisture, and other destroying influences, the surface of the painting is sometimes so much incrusted with dirt as to make a good copy from it an impossibility. If it is practicable, which sometimes it is not, the picture should be cleaned with a soft sponge, water and soap, and, after allowing to dry slowly, rubbed over first with a dry soft sponge, and afterward with oil or glycerine and water.

Line engravings, manuscripts, and other old documents, yellowed by age, copy exceedingly well upon erythrosine plates; and equally so do old photographs. The grain of the paper, making enlarged photographs look rough and coarse, disappears almost entirely upon orthochromatic plates, and they are used, therefore, for that purpose quite extensively. In fact, for all kinds of photographic copying, with the exception, perhaps, of those showing pure whites and blacks, color-sensitive plates do good service.—*Photo. Times.*

The Detroit Electric Street Railway.

"Do you make any speed with the electric motor?" a reporter of the Detroit *Free Press* asked of Frank H. Fisher, inventor of the system in use on the Highland Park road.

"Come out and receive a practical demonstration," was the reply.

The invitation was accepted, and shortly afterward the young inventor and the reporter were at the power station. Here were found two dynamos, one for operating two cars and a larger one for handling six. These dynamos are driven by one engine, and it was impossible to tell that the machines were delivering the current to the track, there being no spark and very little noise. The current is taken to the car by means of a third rail, which in the city limits is placed in a conduit entirely below the level of the street, but at the toll gate it is raised somewhat and protected by wooden stringers on the remainder of the road. The equipment of the road has been largely increased, and cars now run every half hour. While inspecting the conduit, the car Ampere came dashing down the track. It had hardly stopped when the crowd of waiting passengers began to scramble for seats. Mr. Fisher and the reporter took a position on the front platform. The conductor gave the customary yell of "All aboard," and then a signal to the motor man. The latter didn't yell "Get up," and pound a tired horse with a whip. He simply moved a little switch, and the car glided noiselessly and rapidly in the direction of Highland Park. The trip to the end of the road, which is three and one-half miles, was made in fifteen minutes. On reaching the switch, the car Volta passed without any perceptible difference of speed in either car. This explodes the erroneous idea that two cars going in opposite directions and propelled by electric currents cannot pass each other. On the return trip, when the pretty stretch of road from the post office to Kaiser's was reached, Mr. Fisher gave a signal to the motor man, who moved another switch and "let her out." The car shot forward, and rushed past Highland Park and Captain Stevens' farm at a rate of twenty-five miles per hour. The speed was maintained until the switch was reached, when it slowed down to twelve miles an hour into the city.

The new cars Franklin and Faraday, recently placed on the road, show marked improvement in mechanical construction. The motors are placed on the front platform, entirely out of the way of passengers, and there is an entire absence of wires and other paraphernalia. Each car is provided with an ammeter, which indicates the amount of current being used by the motor. The cars themselves, which were built by the Pullman Company, of Detroit, are fine specimens of railway architecture.

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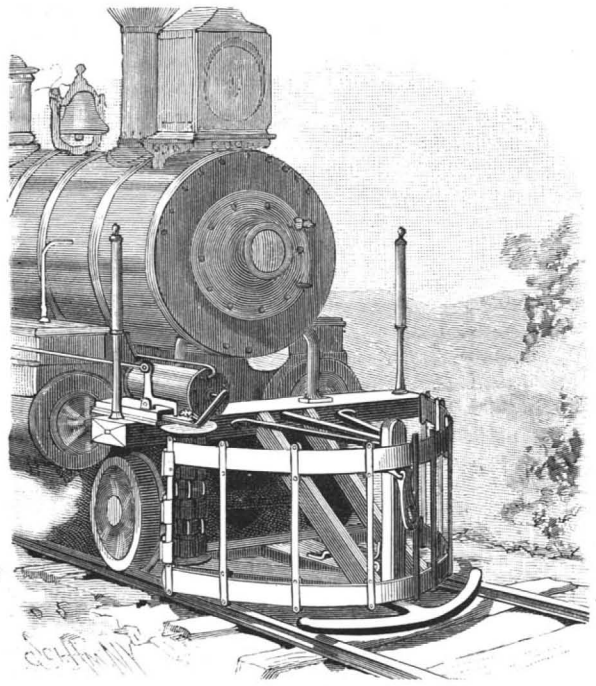
LOCOMOTIVE ATTACHMENT FOR REMOVING OBSTRUCTIONS FROM RAILROAD TRACKS.

The invention herewith illustrated provides a device to be attached to locomotives to be used in place of the pilot or attached to the ordinary pilot. It consists of a spring frame secured to the front of the locomotive, and arranged to be bowed in upright position where the cow catcher ordinarily



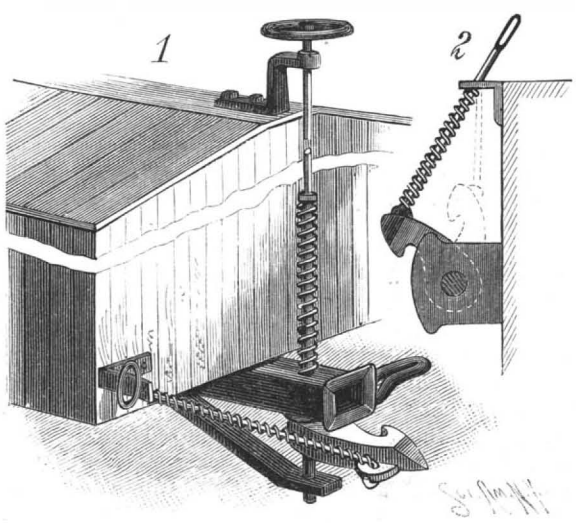
ALEXANDER'S LOCOMOTIVE ATTACHMENT.

comes. There is a spring-actuated catch for retaining it under strain, and a bar connected therewith for releasing the spring frame by contact with an obstruction on the track, the contact point of the device extending a few inches beyond the frame, at the bottom, just above the rails. When this contact point is struck by an obstruction in front of a train, the spring frame is released, and in straightening out, removes the obstruction to one side of the track, out of the path of the locomotive. Should the engineer at any time desire to prevent the operation of the device, he can do so by a pawl lever within convenient reach.

This invention has been patented by Mr. Tony Alexander, of Bogue Chitto, Lincoln County, Miss.

AN IMPROVED CAR COUPLER.

A car coupler especially adapted for freight cars, that is simple in construction and is designed to be automatic in its action, is shown in the accompanying illustration, and has been patented by Mr. Eugene A. De May, of Richmond, Texas. The shaft journaled in a bracket at the top of the car, and supported at its lower end by a brace attached to the drawbar, is adapted to carry not only a coupling hook, but also an ordinary form of bent link, by which to couple to a car that is not provided with this improved coupler. The spiral spring upon this upright shaft is capable of lifting and sustaining the shaft and parts carried thereby. Upon the back of the coupling hook is an apertured ear, which receives a hook formed on a bar carrying a spiral spring, which tends to press the hook forward into the position



DE MAY'S CAR COUPLER.

of use, this bar being held at its other end by a latch in a bracket at the side of the car, so that the coupling hook may be held open thereby, as indicated in dotted lines in Fig. 2. When it is desired to prevent the engagement of the coupling hooks while the train is in motion, and it is inconvenient to operate the hooks by the rods at the side, they may be thrown to one side to prevent engagement by simply pressing down upon the upright bar from the top of the car, thereby bringing the hook out of the path of the hook of the adjoining car. This improvement can be fitted to almost any drawbar, and, with the link, made to couple with the old style drawheads, or with high and low drawbars, while it can be taken off and replaced in a few minutes.

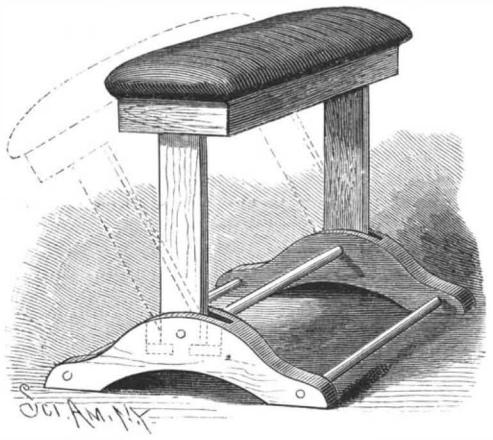
Tannin in Boiler Incrustation.

Mr. Villon, engineer and chemist, after five months' experimentation with various tannins in order to ascertain which is most effective in preventing the incrustation of boilers, states, in the *Chronique Industrielle*, that the best results are given by *Rumex hymenosepalum*, a species of dock that grows plentifully in sandy soils in a large territory on both sides of the Rio Grande, and from there northward over a large portion of Western Texas. The bulbous root (called "canaigre") is the part used. The roots are produced in clusters weighing several pounds. They contain 25 per cent of tannin, along with gum, starch, and ligneous matter.

A liquid extract is made from them which is purified with acetate of zinc in order to remove the gum and resin, and a brown liquid is obtained marking 20° B. Of this, 5 grammes (75 grains) per hydrotimetric degree of water and per cubic meter (264 gallons) are used.

AN IMPROVED FOOT REST.

A foot rest designed to be used by the occupant of a rocking chair, and arranged to oscillate to follow the movements of the rocker, is shown in the accompanying illustration, and has been patented by Mr. James W. Tilley, of the Beacon Oil Works, East Boston, Mass. In the end pieces of the base are formed mortises, in which are pivoted the lower ends of the uprights, the latter each having a tenon which extends nearly to the bottom of the mortise, rubber springs being placed upon opposite sides of the tenons. The position of these springs, and the oscillating motion of the top of the foot rest, are represented in dotted lines in the illustration, the springs normally holding the uprights in a vertical position. This foot rest may also be made adjustable as to height, the uprights then being made



TILLEY'S FOOT REST.

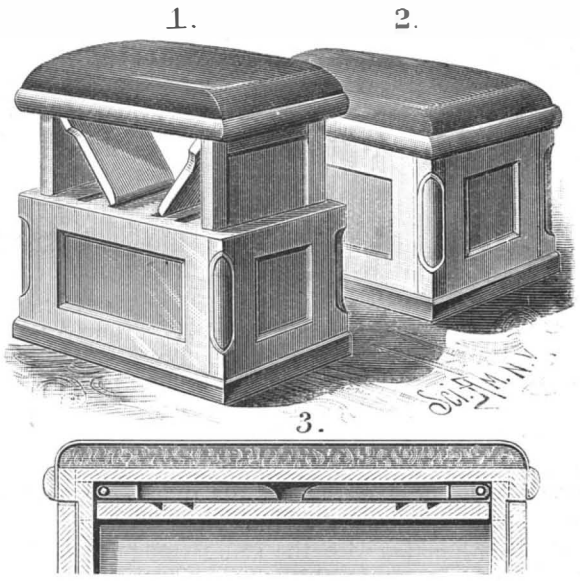
with telescopic legs, and the top is made hollow, to form a receptacle for slippers, brushes, and other articles.

Delicacy of the Sense of Smell.

The only trustworthy determinations of the quantities of substances necessary to excite the sense of smell have been hitherto carried out by Valentin. He found that the quantities thus capable of recognition were 1-600 mg. bromine, 1-5000 hydrogen sulphide, and 1-20,000 oil of roses. The authors have undertaken analogous experiments with other strongly smelling substances, and have arrived at still smaller values. For the experiments they used an empty room containing 230 cubic meters, with painted walls and a stone floor. Of the substance to be examined, 1 grm. was weighed out, dissolved in 1 liter of pure alcohol, and 5 c. c. of this solution were again diluted with alcohol in known proportions. Of this last mixture from 1 to 3 c. c. were measured into a small flask closed with a cork provided with two bent glass tubes. The weighing, diluting, and measuring the odoriferous substance was carried on in the laboratory far distant from the room, and by a person not engaged in the experiment. For the experiment the contents of the flask were evaporated by one of the authors by means of a small hand blast, all openings of the room having been first closed, which required from five to ten minutes, and the air of the room was then very carefully mixed and agitated for ten minutes by means of a large flag. At a signal the other author entered to test the odor. The result was further checked by an independent observer. In one of the experiments the quantity of mercaptan evaporated was 0·01 mg. This was faintly but distinctly recognized. The proportion of mercaptan to the air was in round numbers 1 : 50,000,000,000, and the quantity which could come in contact with the olfactory nerves was 1-460,000,000 mg. This quantity is 250 times smaller than the quantity of sodium detected spectroscopically by Kirchhoff and Bunsen. Hence mercaptan may be utilized in experiments on currents of air, the diffusion of gases, the efficacy of arrangements for ventilation.—*E. Fischer and Fr. Penzoldt, Liebig's Annalen der Chemie.*

A SEWING MACHINE COVER AND STOOL.

A convenient cover for sewing machines, which may also be readily adjusted as a seat for the operator or others, is shown in the accompanying illustration, and forms the subject of a recent patent. The box has the general form of an ordinary sewing machine cover, but its top is cut away to form slots at the ends, opening to the interior, and has two notched grooves near the



ROBERTSON'S SEWING MACHINE COVER AND STOOL.

ends. The uprights of the part forming the stool top pass through these slots, but have cross connecting strips to prevent their being withdrawn from the box. On the under side of the stool top are hinged supporting leaves or legs, their lower ends being beveled to adapt them to be engaged by the notches in the top of the cover. A sectional view of the top, showing these leaves folded under, is given in Fig. 3, Fig. 1 showing them in the position forming the stool, and Fig. 2 representing the device as a simple sewing machine cover.

For further information relative to this invention, address the patentee, Mr. H. Clarence Robertson, care of Messrs. Robertson, Taylor & Williams, Charleston, South Carolina.

AN IMPROVED CHURN.

A churn which may be given either a rocking or a rotary motion to effect the separation of the butter is shown in the accompanying illustration, and has been patented by Mr. Richard Deighton, of Shawnee Mound, Henry County, Mo. The supporting frame consists of oppositely inclined legs hinged together near the top, and held in upright position by eyebolts or pins above the hinges, the frame being readily folded together when the pins are withdrawn. The churn is held in the frame by a two-part circular clamp band, and a frame dependent therefrom, the clamp band also carrying short journals having bearings in the upper ends of the legs of the supporting frame. This dependent frame, in which the body of the churn sits, is secured to

DEIGHTON'S CHURN.

the clamp band by means of pins, whereby the body of the churn may be hung low, when it is desired to operate it with a rocking motion, as shown in the illustration, or the body of the churn may be secured higher up in the clamp band when the churning is to be effected by a rotary motion. The two parts of the clamp band are firmly held around the churn body by screw bolts, and the cover has a suitable packing, while different handles are provided for the two methods of operating the churn.

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High Ballooning.

The aeronauts Mallet and Jovis made an ascent, August 13, in the balloon Horla, starting from the Lavillette gas works, Paris. Their object was to penetrate to the greatest height at which it is possible to live. After a few hours' voyage in the air the balloon descended, landing in the village of Marche, Belgium. They reached an altitude of a little over four miles. This telegram has been received from M. Jovis:

"Victory! We attained an altitude of over 7,000 meters. We were obliged to descend for want of ballast. The conditions were excellent, except that M. Mallet fainted twice. The apparatus is intact."

COMBINED MEASURING JACKETS AND PATTERNS.

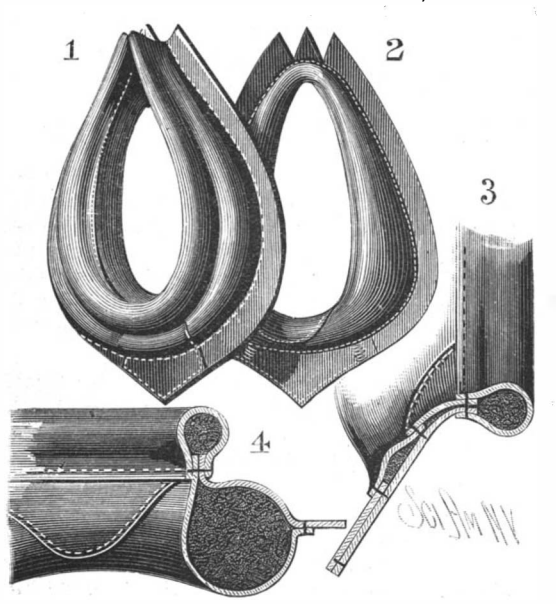
A measuring jacket made up of separable portions, with its side and shoulder seams overlapped and united by flexible cords, and portions of tape lines attached under the overlapping parts, is illustrated herewith, and has been patented by Mr. John Weir, of 122 South Jefferson Street, Dayton, Ohio. The jacket has two back pieces united down the center by a permanent seam, and two combined side and front pieces, with sleeves carrying sliding cuffs, permanently set into their armholes. The back and side pieces are overlapped and united by double rows of elastic cords, as are also the shoulder seams of the back and front pieces, convenient straps with buckles or hooks uniting the front pieces across the breast, in fitting the jacket to a person. In this manner an elastic jacket is formed which can be made to fit persons of different sizes and shapes. In connection with the jacket, patterns are provided corresponding in shape and size with the pieces forming the jacket, the patterns having marks to correspond with

WEIR'S MEASURING JACKET.

the positions of the tapes, from which the exact measures afforded by the jacket can be readily transferred to the cloth, thus avoiding mistakes and reducing to a minimum the labor of measuring and cutting.

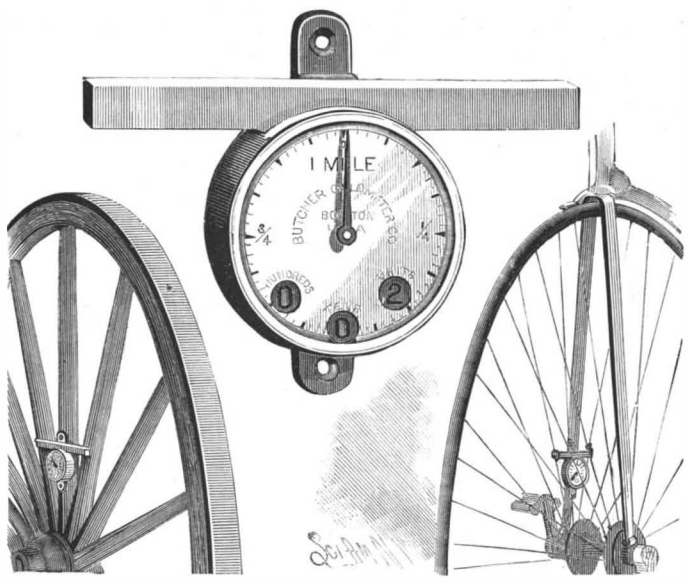
AN IMPROVED HORSE COLLAR.

A horse collar which can be made very strong, and at the same time be flexible at the bottom, so that it can



BOLESKA'S HORSE COLLAR.

be easily passed over the horse's head, is represented in the accompanying illustration, and has been patented by Mr. Joseph Boleska, of No. 1802 South Thirteenth Street, St. Louis, Mo. Figs. 1 and 2 are front and rear views, and Figs. 3 and 4 are views in section. The front roll and the pads are both stuffed in the usual manner, but at the bottom of the front roll a diamond shaped piece of leather is stitched in with the leather composing the pads, above this being secured a flap, stitched at its edge to the pads. The leather forming the pads is bulged outward near the bottom to form a cushion, which serves to protect the horse's throat and prevent him from being choked.



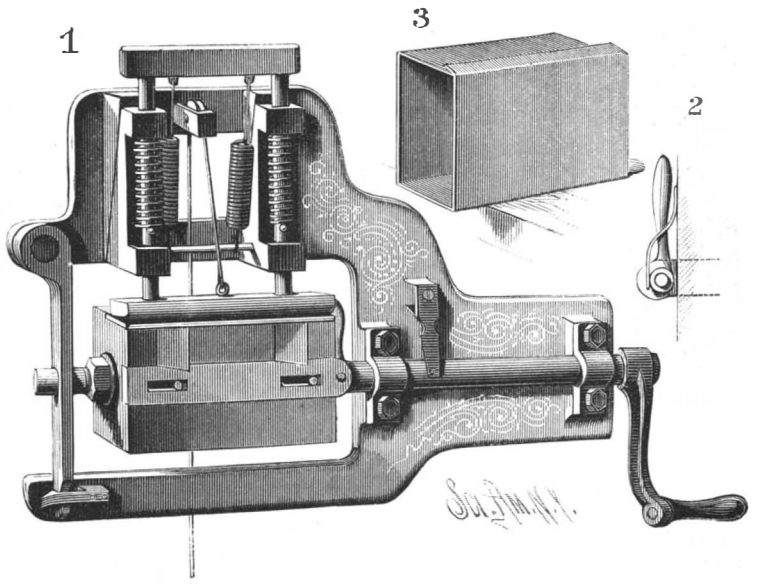
AN IMPROVED ODOMETER OR SPOKE CYCLOMETER.

AN IMPROVED ODOMETER.

The illustration herewith shows an improved device, recently patented, for measuring the distance traveled, either by an ordinary carriage or by bicycles or tricycles. The action of this odometer, or spoke cyclometer, is caused by a sliding rod or weight inclosed in the cross bar at the top. The instrument is screwed to one of the spokes of a wagon or carriage wheel, as near the hub as possible; and with every revolution of the wheel the sliding rod, traveling across the direct line of centrifugal force, operates a worm and gear within the small case, the front dial showing a change in the unit place for each mile traveled, and correspondingly in the places of tens and hundreds for tens and hundreds of miles, all returning to zero on the completion of the one thousandth mile. The sliding rod or weight within the bar strikes at either end against a buffer, and its motion is so great in length that all possibility of jar affecting it is obviated, while its action is positive and certain up to much greater speeds than have ever yet been made, either by bicyclists or the best trotters. These instruments are now being made and used for all sizes of wheels by the Butcher Cyclometer Company, of Nos. 6 and 8 Berkeley Street, Boston, Mass.

A MACHINE FOR FORMING SQUARE TIN CANS.

The special construction of tin can machine herewith shown has been patented by Messrs. James W. Hazen and Charles F. Merrill, of Woodstock, Vt. The former is secured upon a crank shaft journaled in boxes on the main frame, the outer end of the crank shaft being also journaled in a hinged arm. The former, at one edge, has a holder or shallow space to receive the edge of the tin to be bent; and for firmly grasping its edge there are fitted, in shallow recesses on the face of the former, sliding plates, with inclined ends, in contact with cams of a central sliding plate on the same face. This plate is moved longitudinally by a pivoted lever at one side, shown in Fig. 2, the lever and plate being moved back by the action of a spring. A presser-foot or follower is held in contact with the former by springs so arranged that the follower may be adjusted both vertically and horizontally to suit formers of different sizes. As the former is revolved by the crank, the follower folds the tin at the corners and wraps it entirely around the form, the follower being held away from the form as required by a cord or wire running over a pulley at the top, and thence down to a treadle. The meeting ends of the sheet tin being soldered together, the hinged arm at the left is swung outward and the can body slid endwise off from the former. This arm is held in closed position by a catch, and the crank shaft is prevented from being turned in the wrong direction by a catch attached to the main frame, and adapted to engage with a small stud in the shaft.



HAZEN & MERRILL'S TIN CAN MACHINE.

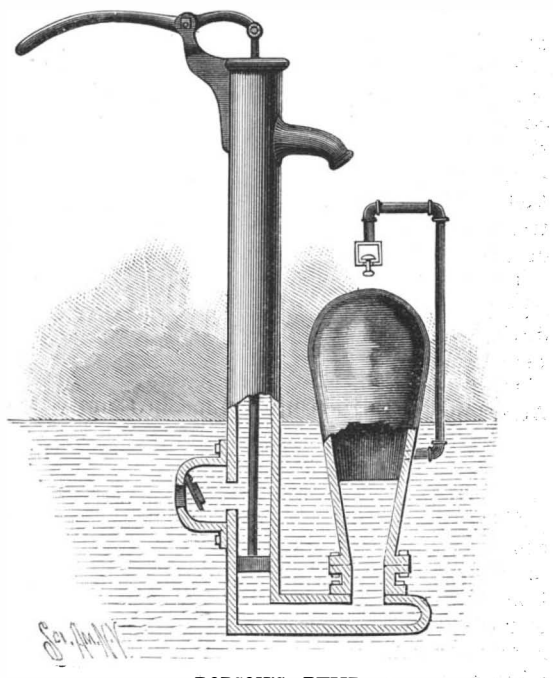
TURNER'S "Antwerp," which was sold in 1833 for $1,000, was lately sold in London for $34,000.

Artesian Well at Galveston.

An artesian well is being bored at Galveston. The city stands on a narrow sand spit, which fences off Galveston Bay from the Gulf of Mexico, and is surrounded by water, being at different places from two to forty miles from the mainland. It is therefore a peculiar place for an artesian well. So far a depth of 658 ft. has been reached. The following is the stratification passed through: Quicksand, 32 ft.; blue clay, 17 ft.; coarse sand, 26 ft.; white clay, 107 ft.; sea mud, 57 ft.; olive clay, 116 ft.; sea mud, 130 ft.; blue clay, 26 ft.; sea mud, 11 ft.; blue clay, 147 ft.; total, 658 ft. At a depth of 500 ft. several palmetto logs were passed through. At present a 9 in. tube is being sunk.

AN IMPROVED PUMP.

The illustration herewith shows a form of pump that has recently been patented by Mr. Robert F. Dobson, of Darlington, Wis. In operation, the liquid is first placed in the vertical tube, after which the piston is introduced and forced to its position below the valve chamber, thus compressing the air in the air chamber, the pressure upon each side of the piston equalizing itself. When the piston is at the end of the down stroke, there is space enough above the upper face of the piston and in the horizontal tube connecting the air chamber with the vertical tube to allow the passage of the water from the vertical tube to the air chamber and from the air chamber to the vertical tube. When the air in the air chamber becomes rarefied, or a partial vacuum is formed, the valve is lifted by external atmospheric pressure, to supply the waste of air from the chamber.



DOBSON'S PUMP.

For further particulars concerning this invention, application should be made to Messrs. Dobson & Bray, P. O. box No. 7, Darlington, Wis.

The Names Microphone and Telephone.

According to the *Electrician*, the word *microphone* was applied for the first time, in 1827, to an instrument invented by Wheatstone, and designed to render the slightest sounds audible.

The word *telephone* was used in 1845 to designate an apparatus invented by Captain John Taylor, for the transmission of signals during a fog by means of the sounds produced by the passage of compressed air through trumpets.

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The Proposed Tunnel under the English Channel between England and France.

This great enterprise, championed by Sir Edward Watkin, still lacks the authority of Parliament, and remains in *statu quo*. The preliminary borings on each side of the Channel have been carried a few miles—far enough to demonstrate beyond question the commercial and practical feasibility of the work.

To all the world outside of Great Britain the project commends itself as desirable for the public convenience; but the majority of Englishmen disapprove it, owing to the mortal fear they have of the French. They are afraid, in case of war, it will be impossible to prevent the Gauls from making a rush through the tunnel and capturing the entire country. Here are some of the latest and brightest British ideas upon the subject, expressed by the editor of the *Broad Arrow*, a semi-official military organ of the army and navy:

"From a purely naval point of view, the Channel tunnel scheme is most undesirable. Allow for instance that the command of the Channel passed from our hands for the space of six hours only, that is to say, that one of our many vulnerable spots on the south coast of England was denuded of its naval protection for the above-mentioned space of time. There are many ways in which this dire result could be brought about: for instance, a false alarm raised purposely at either end of the station to lure the ships away; secondly, a sufficiently strong squadron to enact the part of a forlorn hope and sacrifice themselves, caring nothing so that the landing be effected; and lastly, though by no means the least unlikely, there is the fog and thick weather, in which a flotilla could reach our shores. We say by no means the least unlikely, because the thick weather that would aid them in their unseen passage across the Channel would also aid them to assemble at their *point d'appui* for their dash across. . . . From Shoreham, where there is a tidal harbor easy of access, and with no particular means of defense, the Channel tunnel at Dover is within striking distance of an enemy who shall have six hours at his disposal. Aided as he naturally would be by the South Coast Railway and contiguous lines, with such a prize in view as the tunnel, it may be doubted if the hostile general would take more notice of Brighton than calling for the mayor and such resident notabilities as he could "grab." . . . Then when our squadrons returned to their stations, they would find themselves powerless any longer to protect these shores, in consequence of the pernicious Channel tunnel pouring forth the legions of the hostile army into this country, assuming that the first corps that landed had been successful in their operations to take the tunnel. . . . Sir Edward Watkin would, in his great scheme, create for us a military frontier which we do not covet, compel us to have recourse to a conscription, to treble our naval and military armaments, and to place an inviting gateway at Dover in the shape of a fortress, which, if captured by stratagem or *coup de main*, would never be restored until a ruinous tribute sank us for ages into the condition of a fifth or sixth rate power.

The Entire Motive Force of the World.

From a note published by the Bureau of Statistics in Berlin the following very interesting figures are taken.

Four-fifths of the engines now working in the world have been constructed during the last five lustra (25 years).

France has actually 49,590 stationary or locomotive boilers, 7,000 locomotives, and 1,850 boats' boilers; Germany has 59,000 boilers, 10,000 locomotives, and 1,700 ships' boilers; Austria, 12,000 boilers and 2,800 locomotives.

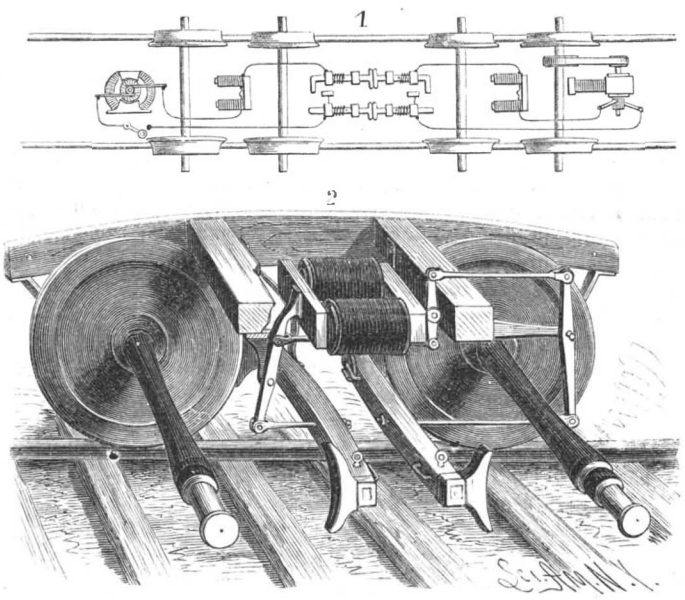
The force equivalent to the working steam engines represents in the United States 7,500,000 horse power, in England 7,000,000 horse power, in Germany 4,500,000, in France 3,000,000, in Austria 1,500,000. In these the motive power of the locomotives is not included, whose number in all the world amounts to 105,000, and represent a total of 3,000,000 horse power. Adding this amount to the other figures, we obtain the total of 46,000,000 horse power.

A steam horse power is equal to three actual horses' power; a living horse is equal to seven men. The steam engines to-day represent in the world approximately the work of a thousand millions of men, or more than double the working population of the earth, whose total population amounts to 1,455,923,000 inhabitants. Steam, therefore, has trebled man's working power, enabling him to economize his physical strength while attending to his intellectual development.

A REMEDY for burns, proposed by M. Dubois (*Jour. de Med. de Nantes*), consists in allowing the contents of a siphon of seltzer water to flow slowly over the affected parts. It quiets the pain almost instantly, and the writer believes it hastens the final cure. He ascribes the good effects to the carbonic acid gas and to the local lowering of the temperature.—*Amer. Jour. Pharm.*

AN IMPROVED ELECTRICAL CAR BRAKE.

The invention herewith illustrated provides an electro-magnetic car brake which may be operated from the locomotive or from one of the cars of the train, with means for maintaining the electric circuit in case of the separation of the cars, and for automatically establishing the circuit when the cars are coupled. Fig. 1 shows a plan of the electrical connections of the train with the dynamo on the locomotive, and Fig. 2 is a side view of one of the trucks, with this improvement applied. Ordinarily, the circuit remains open, but, to apply the brakes, the engineer closes the circuit with a switch lever within convenient reach, thus energizing the magnet with which each truck is provided, by the dynamo on the locomotive, or by another dynamo on the last car of the train, driven by connection with one of the car axles, or by both. Should the train separate, it would cause a circuit to be closed covering the separated part, in connection with the dynamo on the rear car, and the brakes would be automatically applied to stop the motion of this separated portion of the train, the portion in connection with the locomotive still being under control of the switch lever of the engineer as before.



HERRINGTON'S ELECTRO-MAGNETIC CAR BRAKE.

For further information relative to this invention, address Mr. James Herrington, the patentee, or Messrs. Joseph Forker and John Phillips, Sharon, Pa.

The Revolution in the After Treatment of Cataract Operations.

BY JULIAN J. CHISOLM, M.D., SURGEON IN CHARGE OF THE PRESBYTERIAN EYE AND EAR CHARITY HOSPITAL, OF BALTIMORE, MD.

At the meeting of the American Medical Association, in May, 1886, at St. Louis, I brought before the ophthalmological section a statement from Dr. Charles Michel, of St. Louis, that he was treating successfully his cataract extraction cases with eyes closed by adhesive strips and in moderately lighted rooms. The section disapproved the plan, and advised a continuance of the method in universal use of compress bandages and dark rooms. I informed the section that I would put the proposed method on trial, and would report to the section the next year, in Chicago, the results of my experiments. That report has been rendered. During the year, ninety-eight cataract extractions and sixty-nine iridectomies have been performed, with such a percentage of successes as warrants the statement that bandages and dark rooms are not only permanently abandoned at the hospital, but must in the very near future be given up by all ophthalmic surgeons.

During the course of this year's experiments, not only have light isinglass straps superseded the heavy compresses and bandages, but much of the restraint in universal use has been proved useless and arbitrary. Under the belief that when the two lids are made one by the adhesive strap, with the tarsal cartilages acting as splints over the corneal surface, and kept in position by means of the tonic contraction of the palpebral muscle, the eye recently operated upon was thoroughly protected from disturbances, regardless of the movements of the rest of the body, the many restraints in universal practice were one by one abandoned.

First, it was found not necessary to operate in the bed in which the patient was to remain during the after treatment. For this was substituted an operating table of convenient height and width, placed near a large window, from which good light could be had. This permits the operator to complete the manual to his own satisfaction. When the operation for cataract extraction is smoothly done, nine-tenths of the dangers against the restoration of sight are removed.

The next step in the abandoning of restraints was not to put the patients to bed, but to allow them the use of their limbs during the entire treatment. Dr. Michel, the advocate of the light room and light dressing treatment, still adopts the restraints in common use, not allowing his patients to turn from their backs for five days. When at the end of this period their backs were aching, he would allow them to turn over on the side opposite to the eye operated upon. I do not put them to bed at all. After the operation I allow them to use a lounge, bed, or chair, following their own preferences. They go to bed at their usual bedtime hour, sleeping on any side that is most comfortable, and they dress themselves in the morning before breakfast.

For the past four months I have taken another great step forward, and have released the eye not operated upon from being strapped. This was a bold step in defiance of the theory universally accepted, that the movements of the eye when left open must affect the cornea of the other recently cut, and therefore a needful quiet must be secured. However satisfying this theory may be—and we have all adopted it for generations back—the experience at the Presbyterian Eye and Ear Hospital, of Baltimore, has conclusively shown that this restraint was never called for and had never been of any utility, but, on the contrary, of much annoyance and discomfort.

Thus one by one the old rules of universal adoption have been abandoned, and I may say that now the revolution in the after treatment of cataract cases has become complete.

Hereafter there will be no more bandaging, dark rooms, bed operations, bed restraints, diet lists, isolation, or smoked glasses needed. The year's work at the hospital has shown that the red, suffused, watery, sensitive eyes, so constantly seen after cataract operations, were made so by the restraining treatment, and were not necessary accompaniments of the convalescence. Thick bandages, dark rooms, and restraint in bed caused most of these annoyances. When cataract extractions are treated with a very thin, light-colored isinglass strip over one eye as the sole dressing, leaving the other eye open, the patient allowed to enjoy in his chamber the light to which he is daily accustomed, the strap removed at the end of the fifth day, when the corneal wound is perfectly healed, very little sensitiveness or congestion or watering will be found. Convalescence is in this way very much expedited. At the end of the first week the patient can be allowed the privilege of the entire house, and before the two weeks are finished he will be ready for dismissal, with eyes so strong as to need but little protection from smoked glasses.

The fruits of my early experiments were given to the profession in June last, with reasons for the change in treatment. These were deemed satisfactory by many specialists, who, upon my recommendation, determined to try the new plan for themselves. At the Chicago meeting, June 7, 1887, many were found in the section who were as enthusiastic as myself over the new after treatment. Several had used the isinglass strap and light rooms, and expressed themselves as delighted at the beautiful results secured. At my suggestion they have promised to test equally the no bed treatment, leaving one eye open for the guidance of the patient, so as really to remove all restraint. This is to be the dressing of the future, and is an immense advance over the blind groping of both patient and surgeon as now conducted.

My present improved practice is to treat the wound made in the extraction of cataract as if it were an ordinary corneal wound, such as we daily see resulting from accident. Close the eye with a piece of isinglass plaster, and restrict the patient to his chamber for a few days.

What a change is this over the course still adhered to by some as expressed at the Chicago meeting! First preparation of patient, then operating in the bed, the carefully and thoroughly excluding light from both eyes with compresses and head bandages, in a dark room, then restraint in bed, patients not allowed to talk to friends or to eat solid food, must stay on their backs, even with hands tied to prevent an accidental touching of the eyes while asleep, and this cruelty kept up for days in the name of progressive surgery. To be sure, such statements only came from old practitioners, who had been so long running in this deep rut that they could not get out of it, and yet up to one year since this was orthodox practice, sanctioned by every authority on cataract operations.

The work at the Presbyterian Eye and Ear Charity Hospital for the past year has broken the spell, and a number of specialists who have tested successfully the new plan have renounced altogether the old method. From present appearances, it would look as if the dark room and confining after treatment of cataract and iridectomy cases will soon be assigned to the shelves of a surgical museum, and all such patients will be allowed to enjoy the blessed light of day throughout their entire treatment, for their own immediate benefit and also for the comfort of the attendants.—*American Journal of Ophthalmology.*

THE Midland Railway of England is making experiments with steel sleepers.

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ON THE PYROMAGNETIC DYNAMO—A MACHINE FOR PRODUCING ELECTRICITY DIRECTLY FROM FUEL.*

BY THOMAS A. EDISON.

The production of electricity directly from coal is a problem which has occupied the closest attention of the ablest inventors for many years. Could the enormous energy latent in coal be made to appear as electric energy by means of a simple transforming apparatus which accomplishes its results with reasonable economy, it will be conceded probably that the mechanical methods of the entire world would be revolutionized thereby, and that another of those grand steps of progress would be taken of which the nineteenth century so justly boasts.

The simple production of a potential difference by means of heat is as old as Seebeck and Melloni. The science of thermo-electricity thus originated has been developed by Becquerel, by Peltier, by Thomson, and by Tait, and the thermo-batteries of Clamond and of Noe have found many important practical uses. The results already attained in these generators have stimulated research marvelously, and many investigators have believed that in this direction lay the philosopher's stone. Our fellow member Moses G. Farmer worked long and assiduously in this field, producing, it is believed, the most satisfactory results as regards economy which have ever been obtained. But even these results were not very encouraging. He never succeeded in converting one per cent of the energy of the coal into electric energy. Quite recently, Lord Rayleigh has discussed, with his well-known ability, the law of efficiency of the thermo battery from the standpoint of the second law of thermodynamics. And he concludes that for a copper-iron couple, working between the extreme limits of temperature possible for these metals, a conversion of not more than one three-hundredth part of the coal energy can be hoped for. While therefore as a heat engine the thermo cell appears to follow precisely the law of Carnot, and hence may have a theoretical maximum efficiency equal to that of the reversible engine of this eminent philosopher, yet in practice its efficiency falls very far below this theoretical maximum.

It therefore follows that if the result hoped for is to be attained at all, it must obviously be looked for in some other direction than in that of the thermo cell. In considering the matter, another line of investigation suggested itself to me, the results of which I have the honor now to submit to my fellow members of the Physical Section. It has long been known that the magnetism of the magnetic metals, and especially of iron, cobalt, and nickel, is markedly affected by heat. According to Becquerel, nickel loses its power of being magnetized at 400°, iron at a cherry-red heat, and cobalt at a white heat. Since, whenever a magnetic field varies in strength in the vicinity of a conductor, a current is generated in that conductor, it occurred to me that by placing an iron core in a magnetic circuit and by varying the magnetizability of that core, by varying its temperature, it would be possible to generate a current in a coil of wire surrounding this core. This idea constitutes the essential feature of the new generator, which therefore I have called a pyromagnetic generator of electricity.

The principle of utilizing the variation of magnetizability by heat as the basis of electric machines, though clearly applicable to generators, was first applied to the construction of a simple form of heat engine, which I have called a pyromagnetic motor. A description of this motor will help us to understand the generator subsequently constructed.

Suppose a permanent magnet, having a bundle of small tubes made of thin iron placed between its poles, and capable of rotation about an axis perpendicular to the plane of the magnet, after the fashion of an armature. Suppose, farther, that by suitable means, such as a blast or a draught, hot air can be made to pass through these tubes so as to raise them to redness. Suppose that by a flat screen symmetrically placed across the face of this bundle of tubes and covering one-half of them, access of the heated air to the tubes beneath it is prevented. Then it follows that if this screen be so adjusted that its ends are equidistant from the two legs of the magnet, the bundle of tubes will not rotate about the axis, since the cooler and magnetic portions of the tube bundle (*i. e.*, those beneath the screen) will be equidistant from the poles, and will be equally attracted on the two sides. But if the screen be turned about the axis of rotation so that one of its ends is nearer one of the poles and the other nearer the other, then rotation of the bundle will ensue, since the portion under the screen, which is cooler and therefore magnetizable, is continually more strongly attracted than the other and heated portion. This device acts, therefore, as a pyromagnetic motor, the heat now passing through the tubes in such a way as to produce a dissymmetry in the lines of force of the iron field, the rotation being due to the effort to make these symmetrical. The guard plate in this case has an action analogous to that of the commutator in an ordinary armature. The first experimental motor constructed on this principle was heated by means of two small Bunsen burners, arranged with an air blast, and it developed about 700 foot pounds per minute. A second and larger motor is now about finished, which will weigh nearly 1,500 pounds, and is expected to develop about three horse power. In both these machines electro-magnets are used in place of permanent magnets, the current to energize them being derived from an external source. In the latter machine, the air for the combustion is first forced through the tubes to aid in cooling them, and then goes into the furnace at a high temperature.

The earliest experiments in the direction of the pyromagnetic production of electricity were made with a very simple apparatus, consisting of a charged electro-magnet, having a tube of thin iron passing through its cores near their outer ends, a coil of wire being wound round this tube, and including an ordinary sounder delicately adjusted, in its circuit. The tube beneath the coil was covered with asbestos paper. After heating the tube to redness by a gas blast directed into it at one end, a jet of cold air was suddenly substituted for the flame; the sounder at once closed, showing that the change in the magnetizability of the iron had varied the distribution of the lines of force within the coil, and thus had produced a current of electricity in this closed circuit.

The construction of a machine of sufficient size to demonstrate the feasibility of producing continuous currents on the large scale in this way was at once begun, and has only just been completed. The new machine consists of eight distinct elements, each the equivalent of the device already mentioned, consisting of the two legs of an electro-magnet somewhat far apart (twelve inches actually), having at one end the ordinary yoke, and at the other a roll of corrugated sheet iron, 0·005 inch thick, called an interstitial armature; this armature having a coil of wire wound upon it, and separated from direct contact by means of asbestos paper. The eight elements are arranged radially about a common center, and are equidistant, the eight interstitial armatures passing, in fact, through the iron disks which constitute the common pole pieces of all the electro-magnets. The coils wound upon the interstitial armatures are connected directly in series, the whole forming a closed circuit. Through the center of these disks a hollow vertical shaft passes, carrying at its lower end a semicircular plate of fire clay called a guard plate, which, when the shaft is turned, revolves close to the lower ends of the sheet iron armatures, and screens off half of them from the access of heat from below. The shaft carries a cylinder of insulating material, having metallic contact pieces let into it on opposite sides, the line joining them being parallel to the straight edge of the guard plate. Upon this cylinder eight springs press, each of these springs being connected to the wire of the closed circuit above mentioned midway between the coils. The length of the metallic segment is so proportioned that the following spring touches it just as the preceding one leaves it. The springs themselves are so adjusted that each of them comes into contact with its metallic segment just as the preceding coil of the pair to which it is connected is uncovered by the rotation of the guard plate. Upon the same shaft, and above the cylinder just mentioned, a pair of metallic rings are placed, insulated from the shaft, to each of which one of the metallic segments is connected. Brushes pressing upon these rings take off the current produced by the generator.

The entire machine now described is placed upon the top of any suitable furnace, fed by a blast, so that the products of combustion are forced up through those interstitial armatures which are not covered by the guard plate, and raise them to a high temperature. The field magnets when charged magnetize of course only those interstitial armatures which are cold, *i. e.*, those beneath the guard plate. On rotating this plate, the interstitial armatures are successively uncovered on the one side and covered on the other; so that continually during the motion, four of the eight armatures are losing heat and the other four are gaining heat. But those which are losing heat are gaining magnetism, and *vice versa.* Hence, while currents are generated in all the armature coils, since in all the magnetism is varying, the current in the coils beneath the guard plate will be in one direction, while that in the coil exposed to the fire will be in the other. Moreover, whenever an armature passes out from under the guard plate, its condition at once changes; from losing heat and gaining magnetism, it begins to gain heat and to lose magnetism. Hence, at this instant, the current in its coil is reversed; and consequently the line connecting this coil with the one opposite to it constitutes the neutral line or line of commutation, precisely as in the ordinary dynamo. Indeed, the action of the interstitial armature coils of the pyromagnetic dynamo resembles strongly that of the ordinary armature coils of the Gramme ring, not only in the manner of connecting them together, but also in their functions; the change of direction in the current as the magnetism of the field changes sign, in the latter case corresponding closely to the change of current in the former case due to the direction of the temperature change. But it will be observed that while in the Gramme ring the loops between the armature coils are connected to commutator segments equal in number to that of the coils, upon which commutator two brushes press, in the pyromagnetic dynamo the loops between the armature coils are connected to an equal number of brushes (in this case eight), while the commutator segments are only two in number. So that the functions of the commutator and the brushes in this generator are in a certain sense reversed as compared with the ordinary dynamo.

The potential difference developed by this dynamo will obviously depend (1) upon the number of turns of wire on the armature coils, (2) upon the temperature difference in working, (3) upon the rate of temperature variation, and (4) upon the proximity of the maximum point of effect. No advantage will be gained, of course, by raising the temperature of the interstitial armature above the point at which its magnetizability is practically zero, nor will it be advantageous, on the other hand, to cool it below the point where its magnetism is practically a maximum. The points of temperature, therefore, between which, for any given magnetic metal, it is most desirable to work, can be easily determined by an inspection of the curve showing the relations between heat and magnetism for this particular metal. Thus the points of temperature at which the magnetizability is practically zero, as above stated, are a white heat for cobalt, a bright red for iron, and 400° for nickel. On the other hand, while at ordinary temperatures iron has a maximum intensity of magnetization represented by 1,390, its intensity at 220° is 1,360, and hence no commercial advantage is gained by cooling the iron below this temperature. Nickel, however, whose maximum intensity of magnetization at ordinary temperatures is 800, has an intensity of only 380 at 220°. Hence while this metal requires a lower maximum temperature, it also requires a lower minimum one, but it may be worked with much less heat. The rate of the temperature variation is determined by the rapidity with which the guard plate revolves; and this in its turn is dependent upon the rapidity with which the interstitial armature can be cooled and heated. That it may take up and lose heat readily, the sheet iron of which it is made is very thin (only 0·005 inch thick, even when its durability is increased by enameling or nickeling), it is corrugated and rolled up so as to expose a large surface (about 60 square feet for the eight armatures), and hot and cold air are alternately forced through the armature. Experiments already made show that the guard plate can probably be made to revolve 120 times a minute. Since the potential difference is proportional to the number of lines of force cut per second, it is evident that by doubling the speed of rotation twice as many lines of force would flow across the generating coils per second, and the output of energy would be quadrupled. Exactly what thickness of metal is the most suitable for the purpose, what the relative volume occupied by metal and by air space in the interstitial armature should be, what is the best diameter for this armature, or even the best metal, what the best limits of temperature, and what the best speed of rotation to produce the maximum potential difference—all these are questions which must be decided by experiments made upon the generator itself.

The results thus far obtained lead to the conclusion that the economy of production of electric energy from fuel by the pyromagnetic dynamo will be at least equal to and probably greater than that of any of the methods in present use. But the actual output of the dynamo will be less than that of an ordinary dynamo of the same weight. To furnish thirty sixteen-candle lights in a dwelling house would probably require a pyromagnetic generator weighing two or three tons. Since, however, the new dynamo will not interfere with using the excess of energy of the coal for warming the house itself, and since there is no attendance required to keep it running, there would seem to be already a large field of usefulness for it. Moreover, by using the regenerative principle in connection with it, great improvement may be made in its capacity, and its practical utility may very probably equal the interesting scientific principles which it embodies.

* Abstract of paper read before the American Association for the Advancement of Science, New York, August, 1887.

Oil the Waves.

In a pamphlet issued lately by the U. S. Hydrographic Office, Lieut. Underwood says that mineral oils are not so effective for use at sea as vegetable or animal. A comparatively small amount of the right kind of oil, say two quarts per hour, properly used, is sufficient, he asserts, to prevent much damage, both to vessels and to small boats, in heavy seas. The greatest result from oil is obtained in deep water. In a surf, or where water is breaking on a bar, the effect is not so certain; but even in this case oil may be of benefit, and its use is recommended by Lieut. Underwood. He advises that, when an attempt is about to be made to board a wreck, the approaching vessel should use the oil after running as close as possible under the lee of the wreck. The wreck will soon drift into the oil, and then a boat may be sent alongside of her.

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MILLOT'S HYDRAULIC WHEEL.

In the setting up of a hydraulic wheel, the following conditions always have to be satisfied: The water must be led from the head race with the least possible loss of velocity; it must be made to act without shock; and it must be discharged without velocity into the tail race. Such conditions cannot be rigorously fulfilled with undershot wheels, as the water loses a portion of its velocity before reaching the wheel, through friction against the sides of the race, and then, at the moment when it reaches one of the buckets, it suddenly loses its velocity and takes on that of the wheel; and, finally, it leaves the latter with considerable velocity. The performance of such a wheel rarely exceeds 25 per cent.

With the overshot wheel, provided it moves slowly, we obtain better results, since its motion, in which the water in the buckets participates, brings about a centrifugal force that modifies the form of the free surface of the liquid in each bucket. Such surface falls toward the interior of the wheel, and rises toward the exterior, so that the water tends to escape from the bucket before accomplishing its work. On another hand, if the water enters with slight velocity from the channel, it does not produce any shock on running into the buckets, if the wheel is moving slowly, and, when the buckets empty, the water is deposited in the tail race without velocity.

Well arranged overshot wheels utilize 75 per cent of the motive work developed by the action of the water, especially with heads varying from ten to forty feet.

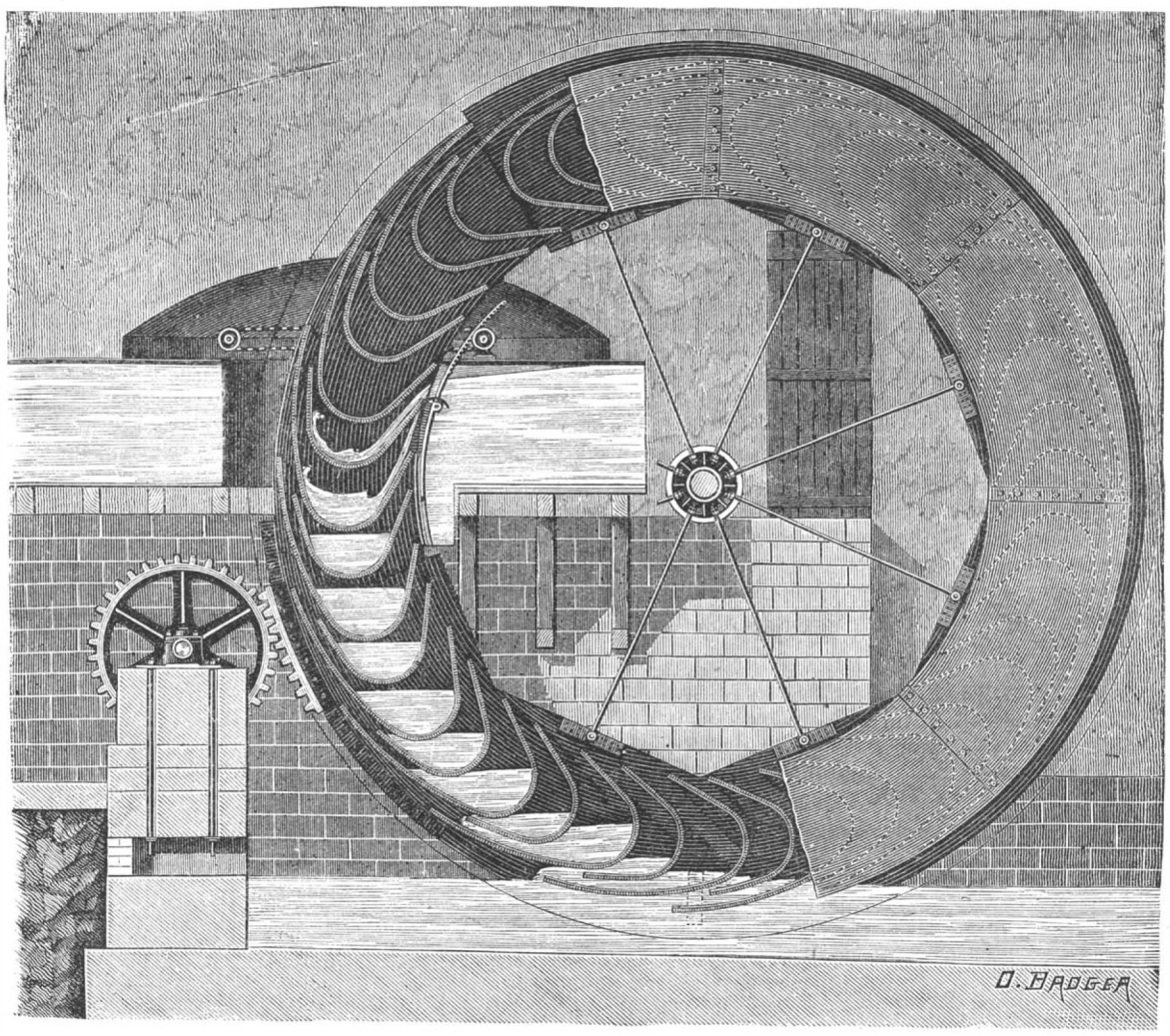
With the breast wheel, the total weight of water that acts does not exert itself solely upon the wheel, for the pressure is merely a component of the weight of the water, and the race supports the other component or part of such weight. It results from this that the wheel, while receiving the same quantity of work from the water, is much less charged, and consequently the friction of its shaft upon the supports is less. But such advantages are counterbalanced by drawbacks due to the fact that the play necessarily existing between the edges of the buckets and the race occasions a loss of water, and also to the fact that the water, in running through the race, experiences quite a good deal of resistance.

To prevent too great a loss of water at this place, it becomes necessary to run the wheel with greater velocity than we do an overshot one, and the result is that the water leaves the wheel with a notable velocity that carries with it a loss of work. This wheel, nevertheless, utilizes about 66 per cent of the work developed by the water.

The Poncelet wheel is an undershot one, so modified as to make it utilize a greater fraction of the work furnished by the water, while at the same time allowing it the advantage of speed. Instead of flat buckets, it has curved ones, and its performance amounts to 60 per cent. The Sagebien wheel is a modification of the breast wheel, which, without being too wide, discharges a large volume of water, thus giving a better performance (80 per cent) than the ordinary breast wheel.

Such are the principal peculiarities of common water wheels.

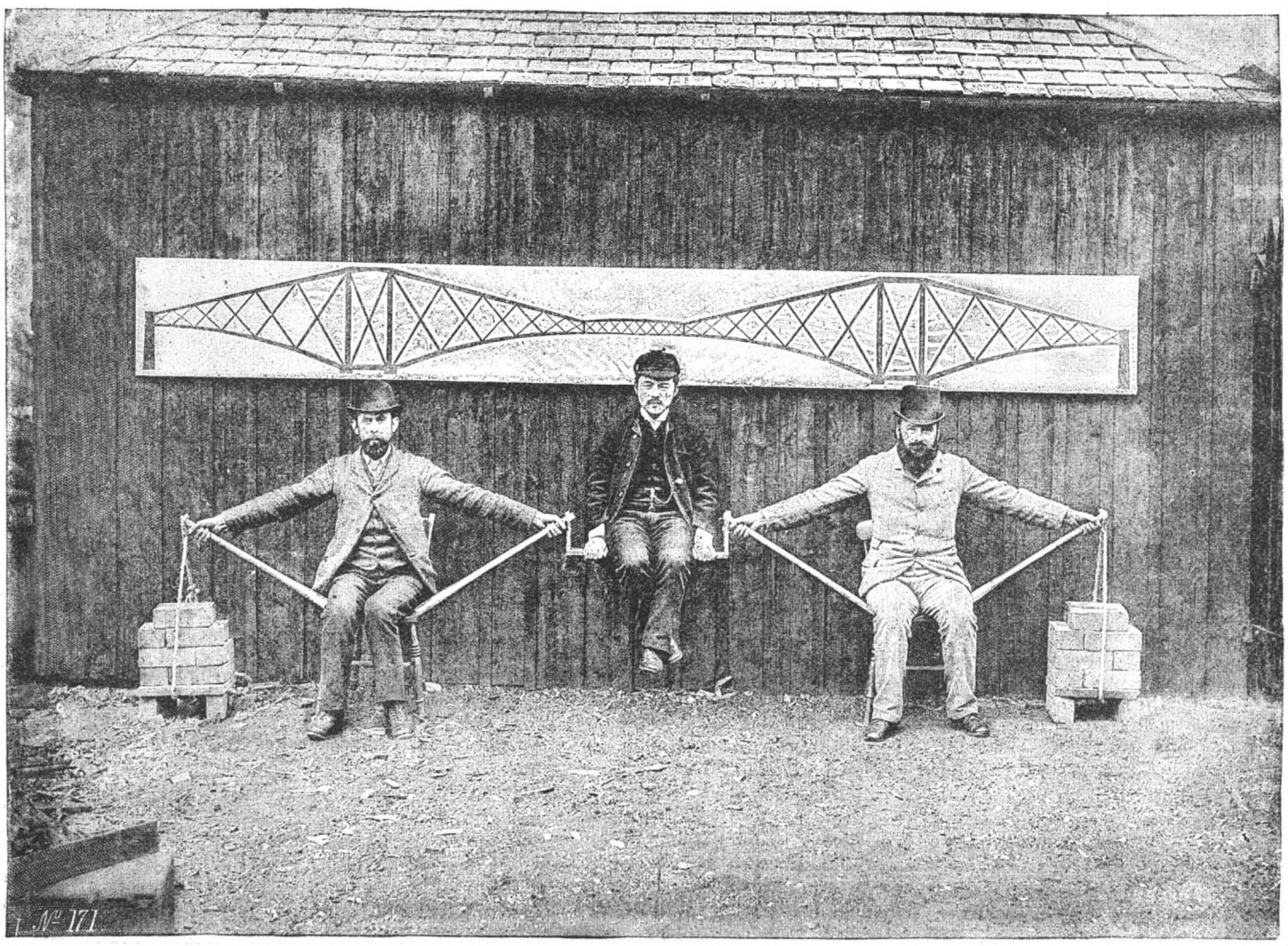
The accompanying figure represents a Millot wheel, as modified by Mr. C. Hauvel. This wheel keeps up a high performance, despite variations in the head of water and in the discharge, since it always utilizes the total height of the fall. Moreover, it admits the water without velocity. Compared with overshot wheels, it presents a greater width of rim, that permits of taking in three or four times more water. If we compare it with breast wheels, or even with the Poncelet water wheel, we find that it does away with the construction and keeping in repair of a wheel race, and it is not exposed to damage or accident from ice or the passage of a foreign body. The objection has been made to it that its diameter is nearly double the height of the fall, and that it is slow, thus multiplying gearings; but the arrangement here illustrated and now used by Mr. Hauvel shows that it is possible to obtain great speed on the driving shaft. As may be seen, the inclination of the buckets allows it to be immersed to some depth without loss, and the slight velocity that is ascribed to it permits of following the current without meeting with resistance therein.



THE MILLOT-HAUVEL WATER WHEEL.

Mr. Hauvel employs iron plate buckets. The interior of the rim is toothed, thus rapidly multiplying the velocity of the driving shaft. The long shafts have been suppressed, and the heavy and cumbersome spokes have been replaced by simple bolted rods, that pass between the two distinct parts of the channel. The head race is thus divided into two portions of water, that join each other on their fall into the bucket. This arrangement, which is simple, light, and strong, is very ingenious.

In order to facilitate the exit of the water, the external lips of the buckets are made alternately long and short, so that the starting section is doubled. This receiver can, therefore, be applied to the utilization of a large discharge without the necessity of increasing its width out of measure. This arrangement does not produce any diminution in the performance due to the anticipated overflow of the water, because the latter does not fall into the race, but into the succeeding bucket. An official committee has found that the performance of this motor reaches 86 per cent.—*Revue Industrielle.*



THE PRINCIPLE OF THE FIRTH OF FORTH BRIDGE.

THE FIRTH OF FORTH BRIDGE

BY B. BAKER, M. INST. C. E.*

If we could transport one of the tubes of the great Britannia Bridge from the Menai Straits to the Forth, we should find it would span little more than one fourth of the space to be spanned by each of the great Forth Bridge girders. And yet it was of this Britannia Bridge that Stephenson, its engineer, thirty years ago, said: "Often at night I would lie tossing about seeking sleep in vain. The tubes filled my

*From a lecture delivered at the Royal Institution.—*Engineering.*

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head. I went to bed with them and got up with them. In the gray of the morning, when I looked across Gloucester Square, it seemed an immense distance across to the houses on the opposite side. It was nearly the same length as the span of my tubular bridge!"

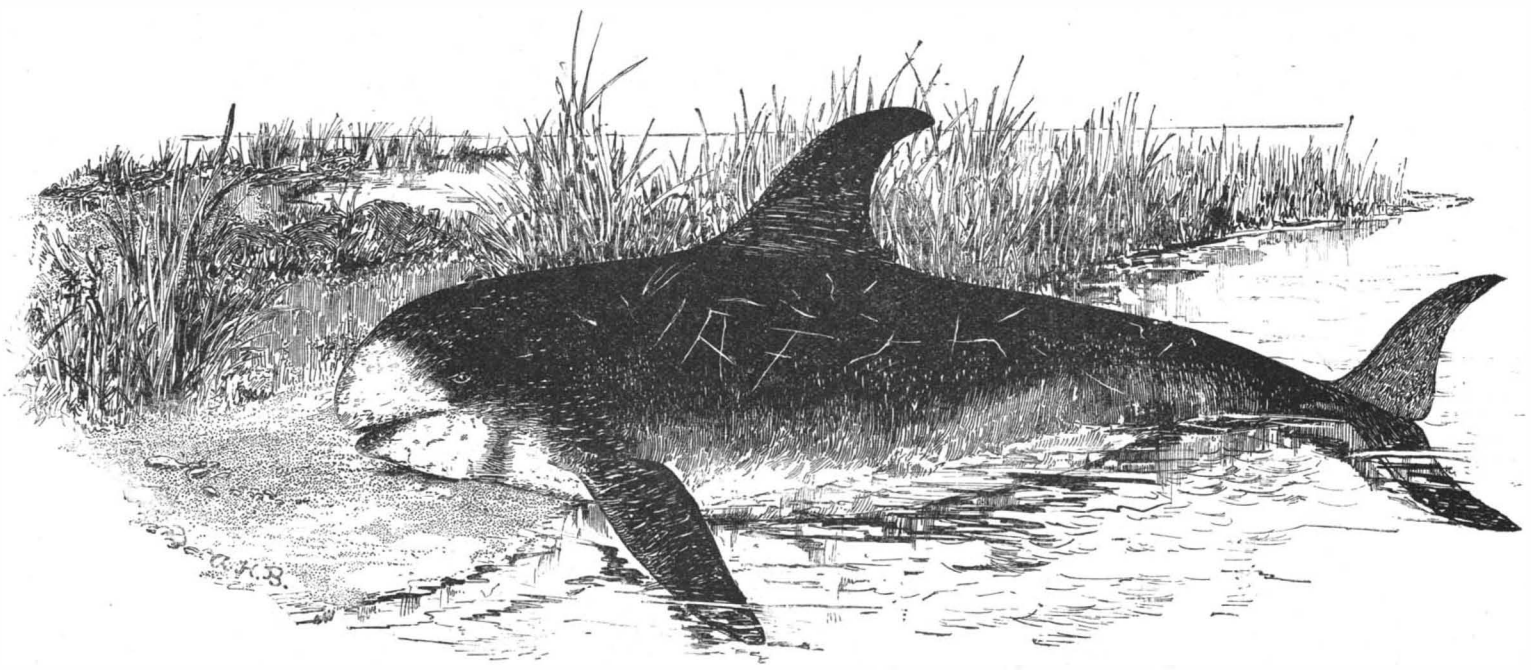
Our spans, as I have said, are each nearly four times as great as Stephenson's. To get an idea of their magnitude, stand in Piccadilly and look toward Buckingham Palace, and then consider that we have to span the entire distance across the Green Park, with a complicated steel structure weighing 15,000 tons, and to erect the same without the possibility of any intermediate pier or support. Consider also that our rail level will be as high above the sea as the top of the dome of the Albert Hall is above street level, and that the structure of our bridge will soar 200 feet yet above that level, or as high as the top of St. Paul's. The bridge would be a startling object indeed in a London landscape.

It is not on account of size only that the Forth Bridge has excited so much general interest, but also because it is of a previously little known type. I will not say novel, for there is nothing new under the sun. It is a cantilever bridge. One of the first questions asked by the generality of visitors at the Forth is, Why do you call it a cantilever bridge? I admit that it is not a satisfactory name, and that it only expresses half the truth, but it is not easy to find a short and satisfactory name for the type. A cantilever is simply another name for a bracket, but a reference to the diagram will show that the 1,700 feet openings of the Forth are spanned by a compound structure consisting of two brackets or cantilevers and one central girder. Owing to the arched form of the under side of the bridge, many persons hold the mistaken notion that the principle of construction is analogous to that of an arch.

In preparing for this lecture the other day, I had to consider how best to make a general audience appreciate the true nature and direction of the stresses on the Forth Bridge; and after consultation with some of our engineers on the spot, a living model of the structure was arranged as follows (see illustration): Two men sitting on chairs extended their arms and supported the same by grasping sticks butting against the chairs. This represented the two double cantilevers. The central girder was represented by a short stick slung from one arm of each man and the anchorages by ropes extending from the other arms to a couple of piles of brick. When stresses are brought on this system by a load on the central girder, the men's arms and the anchorage ropes come into tension and the sticks and chair legs into compression. In the Forth Bridge you have to imagine the chairs placed a third of a mile apart, and the men's heads to be 360 feet above the ground. Their arms are represented by huge steel lattice members, and the sticks or props by steel tubes 12 feet in diameter and 1¼ inches thick.

I have remarked that the principle of the Forth Bridge is not novel. When Lord Napier of Magdala accompanied me over the works one day, he said: "I suppose you touch your hat to the Chinese?" and I replied, "Certainly," as I knew that a number of bridges on the same principle had existed in China for ages past. Indeed, I have evidence that even savages when bridging in primitive style a stream of more than ordinary width have been driven to the adoption of the cantilever and central girder system, as we were driven to it at the Forth. They would find the two cantilevers in the projecting branches of a couple of trees on opposite sides of the river, and they would lash by grass ropes a central piece to the ends of their cantilevers and so form a bridge. This is no imagination, as I have actual sketches of such bridges taken by exploring parties of engineers on the Canadian Pacific and other railways, and in an old book in the British Museum I found an engraving of a most interesting bridge in Thibet upward of 100 feet in span, built between two and three centuries ago and in every respect identical in principle with the Forth Bridge. When I published my first article on the proposed Forth Bridge, some four years ago, I protested against its being stigmatized as a new and untried type of construction, and claimed that it probably had a longer and more respectable ancestry even than the arch.

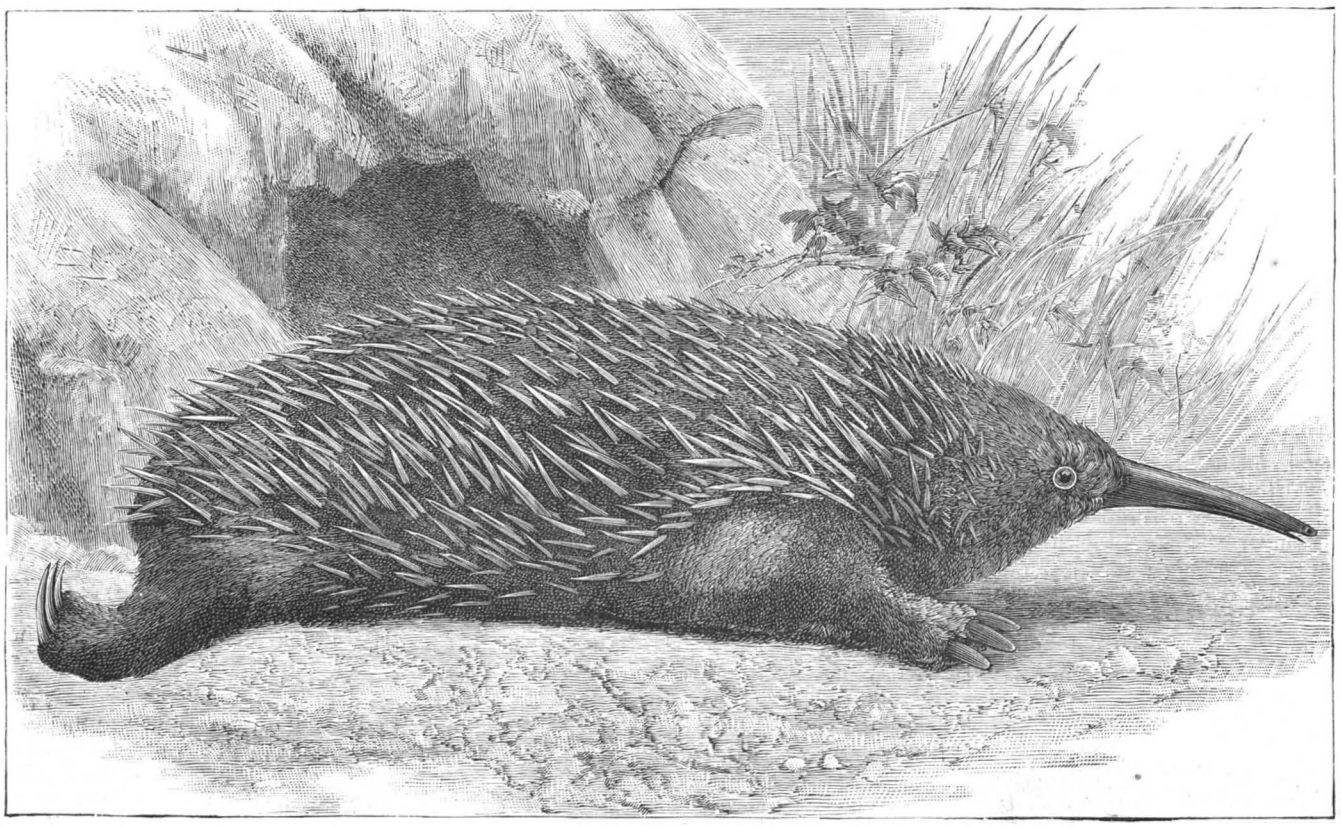
The best evidence of approval is imitation, and I am pleased to be able to tell you that since the first publication of the design for the Forth Bridge, practically every big bridge in the world has been built on the principle of that design, and many others are in progress.



A TATTOOED WHALE.

BRUIJN'S ECHIDNA (PROECHIDNA BRUIJNI), NEW GUINEA ANT EATER.

Our engraving shows the rare and extraordinary echidna that has quite recently been discovered in Northern New Guinea (*Proechidna bruijni*). This curious animal in outward appearance resembles the hedgehogs in its spine-covered body and the ant eaters in its long and tapering snout. The latter is incapable of being opened, and the mouth consists of a small hole at the apex, through which the long and vermiform tongue is protruded. The spines are short and stout, but of needle-like sharpness, and spring from a thick coat of dark brown fur. The forefoot is furnished with three broad and nail-shaped claws, while those of the hinder limb are long, sickle-like, and very sharp. Worked by the powerful muscles with which the creature is provided, these are admirably adapted for digging. The tail is rudimentary. Bruijn's echidna, which is over two feet in length, and is thus considerably larger than its Australian representative, is said by the natives to live in burrows in rocky ground.—*Dr. F. H. H. Guillemard, Cruise of the Marchesa.*



BRUIJN'S ECHIDNA (PROECHIDNA BRUIJNI), NEW GUINEA ANT EATER.

A TATTOOED WHALE.

The accompanying sketch is taken from a cetacean, about twelve feet long, caught in a bluefish gill net by fishermen at Nantucket Island, off Cape Cod, on the fourth of July. Owing to arrangements made with the lighthouse board and life-saving service, in 1883, members of these departments of the government are instructed to inform the commissioner of fisheries, at once, by telegraph, of the occurrence of stranded or captured marine animals such as whales, porpoises, blackfish, and other forms of cetaceans.

Among the papers forming the report of the fish commissioner for 1883 is a circular of instructions to fishermen and others on the coast, giving descriptions and drawings of most of the known forms of cetaceans, and directions for the proper preservation of specimens, so affording sufficient knowledge to secure the safety of valuable and rare forms until they can be taken charge of by the necessary experts.

In consequence of the peculiarity of the animal captured at Nantucket, news of the fact was sent to the summer headquarters of the United States Fish Commission, at Wood's Holl, Mass., and the "whale," as the fishermen described it, was taken there, whence it will be sent, as a skeleton, to the National Museum at Washington, to form a part of the osteological collection there. The animal is a *grampus* (*Grampus griseus*), a species which is somewhat common throughout the North Atlantic.

Several specimens have been taken, their capture being chiefly due to the habit of the species of skirting very near the shore, in pursuit of its food of small fishes and minute surface

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crustaceans. The *grampus* forms one member of the large class of cetaceans occurring in the seas, and is related more or less closely to the porpoise and whale. Having a wide range over the Atlantic, it is not uncommonly seen by vessels. Its habits are similar to those of the rest of the family of cetaceans. Its flesh is sometimes eaten by the fishermen of Cape Cod, and is esteemed very palatable by them.

A peculiarity of the species is the presence of irregular markings or scratches of white on the black sides of the body. These marks appear as though made with some blunt instrument plowed across the skin, but examination shows them to be natural, and they occur on all the specimens, being more numerous as age increases.

In the specimen drawn, the markings assume several irregular forms, and one can easily distinguish the letters A and F. It is said that letters and other signs and outlines are not uncommon, and this animal may be said to carry its own initials on its body, as a sailor bears his name and the symbols of his occupation on his arm or breast.

Alcohol in High Latitudes.

In an interesting article in the *Forum* for August on this subject, General Greely says: "The members of the Lady Franklin Bay expedition, 25 in number, passed two years in an unprecedentedly high latitude, within eight degrees of the geographical pole. During that time many arduous sledge journeys, under conditions of extreme exposure, were made by the men. These journeys varied from 2 to 60 days in length; and owing to the character of the ice and the necessity of transporting with them all supplies used during their absence, such physical exertions were required on the part of the sledgemen that the end of each day's work almost invariably found them in a state of physical exhaustion. The greater part of these journeys were made in temperatures below zero (Fahr.), and for many days at a time the mercury in the thermometer never thawed; while on special occasions temperatures ranging from 50 to 60 degrees below zero, or eighty or ninety below the freezing point, were experienced for a number of consecutive days. And they endured all this labor and exposure without artificial heat, and upon a limited sledge ration, calculated to a nicety, of the least amount of food compatible with health, so that the physical waste was barely repaired. Despite all this exposure and the demands upon the physical strength and vital energy, no case of serious frost bite nor any disabling illness occurred, save in one instance, when Sergeant Rice, the photographer, attacked by inflammatory rheumatism, was brought to camp by a relief party. In this single case Dr. Pavy and Rice, who composed the original party, had abundantly provided themselves with rum from an English cache in Lincoln Bay.

In all these sledge journeys no ration of spirits was ever granted. The officer or non-commissioned officer in charge of the party was provided with a small quantity of brandy for medicinal purposes, which was required, as it proved, only a few times, there being always left a small margin as a gratuitous issue on festal occasions when the sledge party was returning. While at the home station, no spirits of any kind were ever issued regularly. Usually, though not always, on Sunday evenings, about half a gill of rum was issued to each man who desired it; and the same quantity was also given whenever the birthday of one of the party or any other festal occasion occurred.

I cannot recall a single instance where spirits were ever medicinally prescribed at Fort Conger, though there might have been such a case. Generally a small quantity of rum or brandy was given to each member of a sledge party returning from the field, though this was not infrequently declined. In a few cases in the field where spirits were taken during work, or surreptitiously obtained and drunk before the day's work was over, the effect of alcohol seemed to show itself in diminished power for work, in impaired resistance to cold, and in one case it interfered with a man's appetite for the solid food of the sledge ration.

The use of rum in our home quarters at irregular intervals served an excellent purpose in stimulating the mental faculties, which in the cases of some of the men seemed to be deadened and sluggish, owing to the monotonous character of our surroundings and the unvarying routine of duty. During our two years' service at Conger I did not drink in all a pint of spirits, though occasionally I took a glass of light wine; and my own experience was that I was as well without alcohol as with it, though the social effect of wine among the officers was undoubtedly good. Some of the men rarely drank the rum issued, and by common consent these did as well without it as with it; though it seemed certain that some of the party would not have passed the two winters at Conger as cheerfully or as well without alcohol as they did with a small quantity.

During the boat retreat southward from Conger to Cape Sabine, in August and September, 1884, a considerable quantity of rum and whisky was taken with the party, but although there was much exposure from great physical labor, more than half of the journey was completed before the issue of the spirits was begun. It was commenced at a time when the party was somewhat disheartened by the surroundings, and the particular result then sought was to benefit the men mentally rather than physically. The use of rum during the boat retreat appeared to be most beneficial when given to the men just after the day's work was over, and after they had entered their sleeping bags. Before reaction came the men received hot food. Every one who could, avoided drinking the rum until he had entered his bag. The men always expressed most strongly their appreciation of rum and its effects after a day spent in exhausting labors, under discouraging circumstances and with unfortunate results, so that I judged the effect to be a mental stimulant and benefit rather than a physical one. In addition to its effect upon the mind, it produced, in the chilled, damp, and half-frozen men, a marked feeling of warmth, which in my own case appeared to result from an increased surface circulation; and in addition the alcohol evidently had narcotic properties, for it speedily induced drowsiness and greatly promoted sleep. These special issues of rum, either in the field or during the retreat, rarely exceeded half a gill at a time, and when the men received, for urgent reasons or on particular occasions, double the amount, they stated to me that its beneficial result seemed to be little, if any, greater than that of a half gill.

The subject of alcohol was frequently and generally discussed during the winter at Cape Sabine, and all, without exception, concurred in the opinion that spirits should be taken after a day's labor was over, and not before or during exhausting work, nor while suffering from exposure which was to be continued. The opinion of nearly every one was that it should be a constituent of the Arctic sledging ration. My own opinion is the same now as it was in 1881, that in small quantities the issue of alcohol is very beneficial, but that its regular and daily issue would be deleterious rather than beneficial. It should, without doubt, be carried by all expeditions and sledge parties, as a medicine and for emergencies. Dr. Enval, of the Swedish Arctic expedition of 1872–73, says: "I believe spirits and liquors to be of great use in small and moderate quantities, but exceedingly mischievous and pernicious in case of the least excess." The last part of his statement could be verified by me from cases within my own knowledge; as to the first part, it is fully in accord with my own ideas. At Camp Clay, a half gill of rum was issued every Sunday, until the supply was nearly exhausted; and the issue of these spirits to the half-starved, half-frozen, and dispirited men was of the highest possible value. The party looked forward from one Sunday to another as being the feast day, owing in a great measure to this issue of rum. Later, when the party had been slowly starving for many months, and when the supply of food was so diminished as to necessitate a greater reduction of rations, the pure alcohol on hand was issued as food, being diluted with about three times its weight of water. Each man received daily perhaps a quarter of an ounce of alcohol, the effect of which was most beneficial. The general impression, with which I most heartily agreed, was that the alcohol supplemented the food, and had a decided alimentary value. There could be no question of its beneficial effect as a mental stimulus to every member of the party under our unfortunate conditions at Sabine.

It seems to me to follow from these Arctic experiences that the regular use of spirits, even in moderation, under conditions of great physical hardship, continued and exhausting labor, or exposure to severe cold, cannot be too strongly deprecated, and that when used as a mental stimulus or as a physical luxury they should be taken in moderation. When habit or inclination induces the use of alcohol in the field, under conditions noted above, it should be taken only after the day's work is done, as a momentary stimulus while waiting for the preferable hot tea and food; or, better, after the food, when going to bed, for then it may quickly induce sleep and its reaction pass unfelt.

The experiences of the Lady Franklin Bay expedition instance alike the benefit and injury of alcohol on special occasions. The first man to perish, of scurvy and starvation together, was one who was known as a regular drinker. At Sabine, the issue of alcohol in the morning to hunters, on urgent medical recommendations, was followed by the Esquimau Jens, an unerring hunter, missing, at his own chosen distance, a large seal which might have saved the party; afterward, Long, his nerves unaffected by spirits, killed, at the water's edge, a bear over two hundred yards distant. As an instance of the benefit of alcohol may be noticed Sergeant Frederick's remarkable experience, when his shrewd judgment and his proper use of spirits saved his own life under most desperate circumstances of exhaustion and exposure. His gallant comrade, Sergeant Rice, worn out in a fruitless effort to obtain meat for his starving comrades, perished by exhaustion in Frederick's arms. Frederick, having stripped himself to comfort his companion's last hours, found himself chilled and exhausted as well as weakened by months of starvation; but his extraordinary energy and great physical power of endurance were supplemented and stimulated by a mixture of ammonia and brandy.

This article will not have been written in vain if it has the effect of correcting among any class of laboring men the mistaken idea that their capacity for work is increased or their powers of endurance to exposure and cold enhanced by the use of alcohol. The English navvy never drinks while working, and the Esquimaux and Chukches, without alcohol, endure unharmed the severest temperatures known to man.

A. W. GREELY.

The Spirit Level.

There unfortunately exists a great deal of conflicting evidence regarding the true inventors of the different parts of the spirit level. Indeed, there are hardly two authorities who agree upon the subject. The original form seems to have been that of a plummet, and is described as "instrumentum quo, plumbo a filo et gnomone pendente, rectio sive obliquitas operis perpenditur." The great Huygens appears to have been the first to apply the telescope to a level of his which was constructed on the principle of a plummet. The honor of having first applied the air bubble to the determination of horizontality seems to be due to that universal genius Dr. Hooke. From all that I can gather, it appears that his invention must have been made subsequent to March 25, 1674, and prior to the year 1675, as in his "Attempt to prove the motion of the earth by observations," by date March 25, 1674, he describes a new method of stilling the plummet by immersion in water. In his "Animadversions," published also in 1674, after fully describing his invention of the air bubble confined in a tube, he speaks of its peculiar advantage and great delicacy of movement, and remarks: "This can hardly be performed by the ordinary way of plummets, without hanging from a vast height, which is not practically to be performed without almost infinite trouble, expense, and difficulty," etc. Hutton, in his "Mathematical Dictionary," remarks that the application of the air bubble to the level "is said to be due to M. Thevenot," but with what justice I cannot say, having been unable to meet with any reference to this instrument in the writings of that author. Thevenot was born in 1621, and he died in 1692. I have been unable to discover who was the inventor of the circular level, which I imagined had been of recent date; but Switzer, at page 91 of his "Treatise on Water Works," which was published in 1734, remarks that the circular level was then employed in the construction of the surveying instrument called a plane table. According to Sir John Herschel, the cross hair, which gives so much accuracy to all astronomical as well as leveling instruments, was the invention of Gascoigne, a young Englishman, who used it in 1640. He was killed at the age of twenty-three, at the battle of Marston Moor. M. Le Bion appears to have been the first to conjoin the telescope of Huygens with the air bubble of Dr. Hooke; and this must have been subsequent to the year 1684, as such an instrument is not shown in De la Hire's edition of "Picard's Treatise on Leveling." But it was not till Sisson's improvements that the level could be considered as in any way an accurate or philosophic instrument. All that were made previously to his time were coarse instruments, adjusted by a ball and socket, and in other respects resembling the common perambulatory survey level, which, from the nature of the construction, can be leveled in only one direction, and cannot be reversed, or moved even in the slightest degree, without requiring readjustment. Sisson may therefore be considered as the inventor of the instrument in common use. The main feature in his improvements was the introduction of the four screws called the parallel plate screws. I have been unable to find out the date of Sisson's improvement, and, indeed, the only notice I can find of him is the following in Switzer's "System of Water Works:" "The invention" (alluding to the instrument with parallel plate screws), "as I take it (for I am not as yet well acquainted with that gentleman), of William Sisson, at the corner of Beaufort Buildings, in the Strand." Since the time of Sisson, the celebrated Ramsden introduced a tangent screw and clamp, for moving the instrument with accuracy through small distances in an azimuthal direction. Messrs. Troughton & Simms also made several improvements in the arrangement of the various parts of the instrument; and Mr. Gravatt added a cross bubble for facilitating the rough setting of the instrument—or that adjustment which is made with the legs of the tripod; and an enlargement of the diameter of the object glass, so as, by the admission of a greater number of rays of light, to allow of the telescope being shortened, without impairing its optical powers.—*T. Stevenson.*

OUT of twenty young men who competed for a West Point cadetship at Westfield, Mass., ten were rejected by the physician because they had "the tobacco heart," brought on by cigarette smoking. They were unfit for West Point service.—*Boston Traveler.*

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Bids for New Cruisers and Gunboats.

In compliance with the advertisement of April 6 last, with subsequent modification, bids were opened at the Navy Department on August 8 for the construction of the cruiser No. 1, of about 4,000 tons, known as the Newark (cost not to exceed $1,300,000); of cruisers Nos. 4 and 5, of 4,000 tons, known as the 19 knot ships (cost not to exceed $1,500,000 each); and gunboats Nos. 3 and 4, of 1,700 tons, of the type of gunboat No. 1, now building. The description of the twin cruisers is in most respects similar in every detail with that of the Newark. The exceptions are that they are to have machinery of 7,500 indicated horse power under forced draught. The speed is to be 19 knots. The rig is that of a three-masted schooner, spreading 5,400 square feet of sail. Their armament is also to consist of main batteries of twelve 6 inch breech-loading rifles.

Cramp & Sons were the only bidders for cruiser No. 1. Their bid for this vessel, upon department's plan for hull and bidder's plan for machinery, was $1,248,000. But two bids were received for the 19 knot vessels—Messrs. Cramp & Sons at $1,410,000 each and the Union Iron Works at $1,428,000. These bids were based upon the department's plans for both hull and machinery. The Union Iron Works' bid was for one vessel only. Several other bids designated as "special" were submitted by the Messrs. Cramp & Sons for these two vessels—one of $1,325,000 each upon bidder's plans complete, and another of $1,350,000 upon modified plans of the cruiser Baltimore, now building by them. In the bids for gunboats Nos. 3 and 4, Cramp & Sons are cut out narrowly by N. F. Palmer, Jr., & Co., the firm with which Mr. Quintard, John Roach's assignee, is connected. According to the department's designs entirely, Cramp proposes to build the gunboats at $495,000 each. N. F. Palmer & Co.'s bid is just $5,000 less—$490,000 each. As the bids go, it would seem that the three cruisers will probably be built at Cramp's yard in Philadelphia, and the gunboats at Roach's yard at Chester. Mr. Quintard says that if the contract is awarded to Palmer, the hulls will be built at Chester and the machinery at the Quintard Iron Works. The Secretary of the Navy is not bound to accept the lowest or any bid, but he is not likely to reject any of them.

The hull, machinery, and fittings of cruisers Nos. 1, 4, and 5 to be finished within two years from signing the contract, and those of the gunboats Nos. 3 and 6 within eighteen months, with penalties for delay. The weight of the engines and machinery, including water in the surface condensers and boilers, is not to exceed 850 tons for the cruisers and 340 tons for the gunboats, under a penalty of $25,000 and $10,000 respectively for an excess of five per cent in weight, and $1,000 for each ton weight beyond that. The indicated horse power is to be 8,520 for the cruisers and 3,400 for the gunboats, with a premium or penalty of $100 for each horse power in excess or deficient.

Although only three firms competed for the construction of these ships, the Secretary seems well satisfied with the results. He says: "The requirements which the contractors assume are more exacting than in the case of any previous bidding. The law for cruisers Nos. 4 and 5 provides that the contracts for the construction of them shall contain provisions to the effect that the contractor guarantees that when completed and tested for speed, under conditions to be prescribed by the Navy Department, the vessel shall exhibit a maximum speed of at least 19 knots per hour, and for every quarter knot of speed so exhibited over and above said guarantee the contractor shall receive a premium over and above his contract price of $50,000, and for every quarter knot that said vessel fails of reaching said guaranteed speed there shall be deducted from the contract price the sum of $50,000. The department has prescribed a four hours' run for the trial—the vessel to be loaded to the mean load draught—so that there is to be no shamming in the conditions of the trial. This contract is bid for by both the Union Iron Works and Cramp & Sons, and it is a requirement which calls for a boat up to the highest point of speed which these cruisers have reached anywhere. Of course the exactions of the bidding drive off people who are not sure of their ground; but I consider that we are very fortunate in being able to place all of the boats with responsible parties with these very exacting requirements."

Velocity of Electrical Transmission.

Prof. Gould has ascertained that aerial telegraph wires on poles transmit electricity at the rate of from 14,000 to 16,600 miles per second, and that the velocity of transmission increases with the distance between the wires and the earth, or, in other words, with the height of suspension.

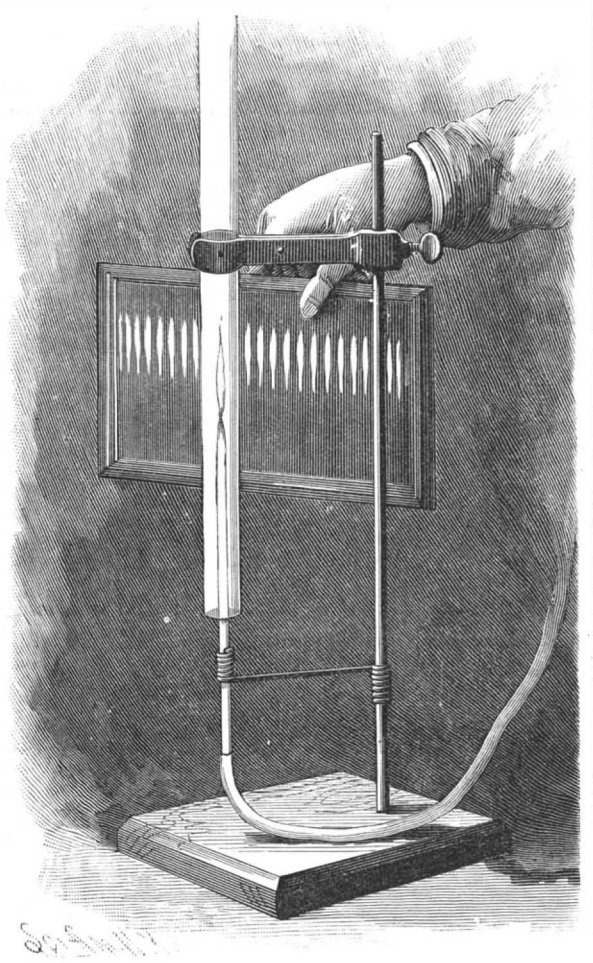
Subterranean wires, like submarine cables, transmit slowly. While wires suspended at a feeble height transmit signals at a velocity of 12,000 miles per second, those that are suspended higher give a velocity of from 16,000 to 24,000 miles. Wheatstone's experiments in 1833 seemed to show a velocity of 288,000 miles per second, but this result has never been confirmed.—*La Lumiere Electrique.*

MUSICAL FLAMES.

BY GEO. M. HOPKINS.

The experiments of Tyndall and others on sounding flames are so interesting and so easily repeated with very simple appliances, that the student of physics, particularly in the department of acoustics, should not fail to repeat them. The production of musical sounds by means of flames inclosed in resonant tubes is especially easy. One form of this experiment is illustrated by the engraving.

For the mere production of sounds, a metal tube will answer, but for the analysis of the flame by which the sound is produced a glass tube will be required. This tube, whether of metal or glass, may be 40 inches long and one inch internal diameter. It should be supported in a fixed vertical position in a suitable support, a filter support, for example. In a lower arm of the support is placed a glass tube three-eighths inch in diameter, having its upper end drawn to a small circular aperture, which will allow sufficient gas to escape to form a pointed flame about 2½ inches in height. The tube is drawn down by heating it near one end until it softens, by continually turning it in a gas flame, then quickly removing it from the flame, and drawing it out as far as possible. By making a nick with a fine file in one side of the tube, at a point where it is about 1-16 inch in diameter, the tube may be broken squarely. It may



PRODUCTION OF SOUNDING FLAMES.

then be tried as a burner. If the flame yielded by gas at full pressure is less than two inches in length, the tube should be again broken off at a point where it is a little larger in diameter, and if the opening happens to be too large, it may be reduced by holding the extreme end of the tube in a gas flame until it partly fuses, when it will contract.

The small glass tube is connected with the gas supply, and the jet is lighted and inserted centrally in the larger tube, and moved slowly upward in the tube until a clear musical note is heard. If the flame is full size, the note will be the fundamental note of the tube. By turning off the gas so as to make the flame three-fourths to one inch high, and again inserting the burner in the tube, a point will be found between its former position and the lower end of the tube at which a tone of higher pitch will be heard. This is one of the harmonics. If the burner with the small flame be carried further upward into the tube, a point will be reached where both the fundamental and harmonic will be produced simultaneously. These tones are produced by rapidly recurring explosions of the gas, the explosions being rendered uniform by the vibratory period of the column of air contained in the tubes.

There are two methods of analyzing these flames. One consists in simply shaking the head, or quickly rolling the eyes from side to side, thereby enabling the eye to receive the impressions of the successive flames in different positions on the retina. The other consists in viewing the image of the flame in a revolving or oscillating mirror. By holding an ordinary looking glass in the hand, opposite the flame, as shown in the engraving, and oscillating the glass, what appears to be a single flame in the tube will be shown as a succession of flames of like form in the mirror.

Another way of showing the intermittent character of the flame consists in revolving a disk having alternating radial bands of black and white, in proximity to the tube, so that the disk is illuminated only by the light of the intermittent flame. When the disk attains a proper speed, the intermittent illumination will cause it to appear stationary. This beautiful experiment is due to Toepler.

By employing a concave mirror instead of a plane one as described above, the image of the flame may be projected upon a screen.

The Berlin Screw Industry.

In reviewing the present situation of the screw industry, the *Berliner Tageblatt* lately remarked that Berlin makes screws in such quantites and of such qualities that its products are esteemed not only in Germany, but in other countries. The principal manufacture is that of fine screws worked bright, from the larger sizes for machinery down to the smaller kinds for watch work, etc.; the materials employed being iron, steel, brass, German silver, etc. Efforts are now being made to increase the production of rough black screws for ordinary wood and iron work; this class of screws having been hitherto principally made in Westphalia, but the development of machinery instead of hand labor in Berlin will, it is considered, alter this situation. There are in the Westphalian district—near Hagen—fifteen screw factories, employing in all about 3,000 workpeople. The Berlin industry comprises twenty-eight factories with about 1,500 workpeople. As these are, however, almost exclusively engaged in the manufacture of screws—while at the various establishments near Hagen only about one-third of the workpeople are employed in this particular industry—it is claimed that Berlin is at least as important a seat of screw manufacture as the Hagen district. Berlin used at one time to draw its supplies of raw material almost entirely from Westphalia, but of late years the constantly increasing employment of ingot iron and ingot steel instead of welded iron has developed the use of Brunswick raw materials—from Peine—which are cheaper than the Westphalian articles, this being partly due to the shorter railway journey they have to make. Steam machinery is exclusively employed for making bright screws, one factory having lately erected a new steam engine of 45 horse power. The screw-making machines in use are upon a system invented by Kernaul some thirty-five years ago, but which has since then been much improved. The manufacture of these screw-making machines constitutes a special branch of Berlin industry. The introduction of the new patent automatic machinery will, it is expected, lead to a further development of the manufacture of screws, more particularly in connection with the making of nuts to go with the larger sizes of normal machine bolts. The history of the Berlin screw manufacture is considered to disprove the assertion that an important metal article can only be made in the immediate vicinity of the works where the raw material is produced. This result is attributed to the intelligence and manual skill of the Berlin workmen. One factory at Kopenik produces annually 2,000,000 steel horseshoe calkins, the steel for which comes from Hagen

Death by Electricity.

A number of interesting experiments have just been made with such electrical machines as are employed in industries, with the view of determining under what conditions they may become dangerous. These have been conducted by M. D'Arsonval, who has already established the fact that what is truly dangerous where these machines are used is the extra current that occurs at the moment the current is broken, and in order to annul this extra current he proposed to interpose a series of voltameters containing acidulated water along the conducting wire. The new arrangement now employed is at once more simple and efficient. It consists of a V-shaped tube made of an insulating substance, which, after being filled with mercury, is interposed in the main current. In order to close the latter it is only necessary to turn a tap, which is arranged similarly to the tap on a gas pipe. In this way the machine is unprimed without its being able to give an extra current spark.

Another arrangement is also made use of, a glass tube being filled with mercury and dipped into a reservoir containing the same substance. This tube is provided with a ground stopper, this not only permitting the suppression of the extra current, but also interposing any sort of resistance in the current. Although these details appear rather technical, they relate to a most important matter. The use of electrical machines is increasing, and it is of practical use to know that currents are not dangerous until a power of 500 volts is reached. It is also of interest to know that the mechanism of death varies with the nature of the electricity used. Thus, with the extra current or with alternating currents, there is no anatomical lesion, and the patient can usually be brought back to life through the practice of artificial respiration, as employed in cases of drowning. The discharge of static electricity from batteries, on the contrary, causes a disorganization of the tissues that renders fruitless all attempts to restore life

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Comparative Locomotion.

Their recent researches on the locomotion of the horse and elephant enable the authors to establish certain analogies and differences presented by the posterior member of these quadrupeds compared with the movement of the lower member in man. The parallelism, which is illustrated by several diagrams, bears both on the slow and rapid motion (walking and running) of the three types here under consideration. Contrary to the general opinion, there appears to exist in the step or pace of the quadrupeds a period of double rest, more prolonged in the hind than in the fore quarters. It is also shown that the trot in the horse corresponds unquestionably with the running action of man, but that elephants have no such action, just as man lacks the gallop of the horse, which in this respect thus stands at the head of the series. But, when urged to quicken their speed, the elephants broke into an action somewhat approaching that assumed by man when passing from a walk to a run. In general, both in slow and rapid motion, the action of the pelvic member remains essentially the same in all three types. The difference between them lies in the action on the concurrent limbs, which is slight between man and the elephant, much greater between these two and the horse. —*MM. Marey and Pages.*

Electric Power Service.

BY T. C. MARTIN.

The rapid introduction of electrical apparatus as soon as its efficiency has been demonstrated is being seen once more in the remarkable growth of the electric motor industry. It was the privilege of the writer just a year ago to bring before the National Electric Light Association, in session at Detroit, a few facts and comments on the subject of the use of motors and the electrical transmission of power as it then presented itself. An enumeration was made of the various places at which motors had been introduced, and a few figures were quoted as to results obtained. But the material then offering itself, though striking, was notably scarce as compared with that forthcoming to-day, and to those who are in any way familiar with the development going on, it is evident that the new work already in hand will, within the next year, dwarf into utter insignificance all that has hitherto been accomplished. Thus it may be mentioned, for instance, that one well-known company shows a total output of over 2,000 small motors; that another concern manufacturing small motors up to about one h. p. has built 2,500 since last November; that another company within about the same time—nine months—has sold 1,000 h. p. of motors; that a fourth has, since going into operation, sold about 2,500 h. p., and is now building some 4,000 h. p.; and that large factories have been put up for the special manufacture of motors, employing hundreds of men. The importance of this new condition of affairs is hardly yet recognized, but it cannot be denied. It means for one thing that even to-day the electric light station is becoming the great public reservoir of power, and that from its circuits all engaged in manufacture, and thousands who need power for various minor services and functions, can draw supplies at will. In a very short time the consumption of current for electric power will equal, if not excel, the consumption for light, and it is to this new idea that electric light men and the general public are adjusting their methods. There is not an electric light station building to-day in which provision is not being made, in engines and dynamos, for electric power supply; nor is there a manufacturing industry, within city limits anywhere, in which the use of electric motors is not to be tried or has not already begun.

It is, of course, well known that several hundred small motors are in use at the present time deriving current from primary batteries. It is also well known that a large number of motors, averaging about 15 h. p. each, have been applied to street railway work; but it is through the medium of electric lighting circuits that the greatest demand for motors has come and is to be met. In order to ascertain what is being done in this field, the *Electrical World* addressed inquiries recently on the subject to about 500 of the largest local lighting companies. It has been fortunate enough to secure replies from between 200 and 300 of these, and the replies constitute a very interesting presentation of the work done in all sections of the country. A large part of the information furnished has been published during the last week or two in these columns, but it may be well to bring out one or two points that are suggested by the replies as a whole.

It appears that not far short of a hundred local companies are now operating motors, generally, but not always, on their day circuits. A noticeable feature of the replies from companies not doing any motor business is that they "do not run day circuits." This may often be a sufficient reason, but the inquiry is admissible whether sufficient current could not be stored up from the average nightly run of a station with a spare or extra dynamo to feed a day circuit profitably. This is certainly worth trying in some places, and is being done at Cheyenne, where several motors are on storage day circuit. Another point brought out is that the motors are largely on incandescent circuits, the reason for this being obviously that day running is far more a necessity with incandescent stations than with arc stations. Where motors are running upon night circuits they are chiefly employed on newspaper presses.

A question among electric light men has been whether it is best to sell the motor or to rent it out. No unanimity has yet been attained, or is likely to be reached, on that head, although in a great many cases the matter of purchase is left optional with the customer. The sale outright relieves the company of a large initial outlay, but the leasing system seems productive of a much larger income in the long run.

Another question arising is that as to the desirability of selling power at a flat rate or by meter. Many of the companies are charging meter rates, but, on the whole, the flat rate, based on the capacity of the motor, appears to have a decided preference.

It will be remembered that the National Electric Light Association has discussed the propriety of fixing motor rates for its members. Pending that action, a striking variety has manifested itself. A few schedules will show this. The following are the rates at Pittsburg:

WHERE COMPANY OWNS MOTOR.	Per month.	WHERE SUBSCRIBER OWNS MOTOR.	Per month.
½ horse power	$10.00	½ horse power	$6.00
1 "	15.00	1 "	10.00
1½ "	22.50	1½ "	15.00
2 "	28.00	2 "	20.00
3 "	40.00	3 "	25.00
5 "	60.00	5 "	40.00
8 "	72.00	8 "	55.00
10 "	80.00	10 "	60.00

The company runs its main line to the premises where the motor is to be placed, but all other connections and appliances for the purpose of utilizing the power from that point are made at the cost of the subscriber.

At Buffalo, N. Y., the following rates are quoted:

Size.	Power per month.	Rental of Motor per month.
⅛ H. P.	$3.00	$0.50
½ "	5.00	1.00
1 "	8.00	1.00
2 "	15.00	2.50
4 "	26.00	5.00
6 "	38.50	7.50
8 "	51.00	10.00
10 "	63.50	12.50
12 "	76.00	15.00

The above quotations are based on a service daily except Sunday, from 7 A. M. to 6 P. M. Special prices are made where power is required for a different period. A discount of $1 per motor is made on bills paid on or before the 10th of month following service. To parties desiring to own their motors the company (Brush) furnishes any size or style. Where motor is furnished by the company, a contract for at least one year's motor use is required.

At Laramie, Wyo., the subjoined schedule has been put in force by the Laramie Electric, Gas Light, and Fuel Company:

Horse power delivered to customers.	Rates per horse power per hour.	Rate for one hour.	Rate per month of 26 days in cases where consumer owns the motor.
40	2½ cents	$1.00	$260.00
20	2½ cents	50	130.00
15	2⅝ cents	37½	97.50
10	3 cents	30	78.00
7½	3½ cents	26¼	68.25
5	4 cents	20	52.00
3	4½ cents	13½	35.10
2	5 cents	10	26.00
1	.....	6	15.00
½	.....	3	7.50
For sewing machines.	.....	.....	2.00

The Laramie station is about to supply 40 h. p. at $260 per month, as above, to a large flouring mill about 150 feet away.

At Detroit, Mich., the Edison Company is charging $100 per h. p. per year, the patron buying his motor. At Boston, the Boston Electric Light Company, on the same basis of purchase, charges 50 cents per day per h. p. At Des Moines, the rate is $100 per year per h. p. for 10 hours daily with work at constant load; and $100 is also charged at Auburn, N. Y., Springfield, Mass., Williamsport, Pa., and Fall River, Mass. At Lawrence, Mass., Lowell, Mass., Harrisburg, Pa., and Providence, $125 is charged. At Cleveland, O., Cincinnati, and Baltimore (over ½ h. p.), $10 per month is charged. At Hutchinson, Kan., and Abilene, Kan., respectively, a 5 h. p. motor runs the press for the morning newspaper at $45 per month. At Pawtucket, $100 per year is the rate where the motor is sold, and $150 where it is rented. At Rochester, N. Y., where the prime power is water, $50 to $72 per h. p. per year is charged; and at Elgin, Ill., where the day run is made by water power, $60 per year is charged for from 7 A. M. to 6 P. M., and 15 cents per h. p. per hour for night work. At Cleveland 24 ⅛ h. p. sewing machine motors are run at $1 each per month. At Galveston, Tex., $15 per month is the rate. At Toledo, O., and Kansas City $2 per month for ⅛ h. p. is being charged, and at Reading, Pa., $1.75 per month. In Boston and New York the rate averages about $100 to $125 per year. Of course, in all cases, larger supply means lower rates.

The work done by the motors now running is endless in its variety, and some of the uses are novel and highly ingenious. A large number of motors have found their way into printing offices, and run the press for such papers as the Lawrence, Mass., *American;* the Detroit, Mich., *Tribune;* the Cincinnati, O., *American Inventor;* the Rochester, N. Y., *Pythian Knight;* the Lowell, Mass., *Daily News* and the *Daily Courier;* the Elgin, Ill., *News;* and the daily journals at Hutchinson and Abilene, Kan. At Detroit a 15 h. p. motor operates machinery giving employment to 200 people, and it is noteworthy that a motor factory in New York is now putting in one of its own motors to give it power from the nearest electric light station. In fact, it is a common thing to find a motor driving large floors of machinery and keeping scores of men busy, as for example in machine shops, shoe factories, clothing stores, printing offices, box factories, book binderies, knitting works, and the like. But the motors can also be found, as these returns show, washing bottles, pumping water from artesian wells at two cents per barrel, brushing down horses, running dental lathes, and driving hundreds of ice cream freezers, coffee mills, ventilating fans, elevators, organs, circular saws, plating apparatus, laundry machines, glove machines, and in throwing colors on portraits. At Pittsburg a 15 h. p. motor is being put in to drive dynamos for the Western Union Telegraph Company, and some are now employed here and there running the generators in telephone exchanges.

It is still early for the establishment of special motor circuits, but there are several now up and more are building in the larger cities. It is to be borne in mind that in New York and Boston a distinct electric power supply (Daft) has existed since 1883, that in New York now distributing over 200 horse power to about 60 customers, and that in Boston 90 horse power to about 20. Similar service exists in Worcester and Providence. A special power plant is also enjoyed by San Francisco, and the steps being taken elsewhere in the same direction are too numerous to record.

It remains to be seen whether the power supply will be generally undertaken by special power stations or whether it will chiefly remain in the hands of the lighting stations. In Boston the Edison light station is running 72 motors (Sprague) from ½ h. p. to 15 h. p., with a total call for 300 h. p. of current, and in New York the Edison wires feed 45 motors of the same make, with the same range of capacity, taking in all 250 h. p. The Brush companies in New York, Rochester, Buffalo, Galveston, and Philadelphia have a large number of motors of different makes in use, and the Brush Company in Baltimore has about 60 motors (Baxter) on its arc circuits. At Providence the Narragansett Electric Light Company is putting about 30 h. p. of motors (Thomson) on independent circuit.

One interesting development in New York City deserves special note. The Excelsior Steam Power Company, established as a private concern about thirty years ago for steam power distribution, and lately delivering nearly 800 h. p. over an area of four city blocks, went into the electric motor business not long ago, running for the Electric Power Company the Daft service above spoken of. It is now understood that the company has completed arrangements for the generation and supply of 2,000 h. p. electrically, using the same system, and is already busy preparing its plant. This service will be confined to the district on the east side of Broadway, another service being meantime planned for the west side, to go into operation by the beginning of September. The Excelsior Company has been leasing its motors, charging $4 per week for 1 h. p., $6 for 2 h. p., and $3 for every additional h. p. This includes the currrent, the use of the machine, supervision, and any needed repairs.

Some of the comments made are very significant, and in no case does it appear that the motor is at a disadvantage as an instrument of power distribution when compared with other machines. Thus it is remarked by the local company at Appleton, Wis., that water power is so cheap it would not pay them to run in the day time for electric power supply. Yet it is in Appleton that the electric motor has made a splendid showing on street railway work, the generator being driven by water wheel. As to the size of motors, it may be said that it was at first thought that the bulk of the business would be around 5 h. p., but the demand is as brisk for motors of 10 and 15 h. p. and larger as for those of any other smaller capacity. All told, there are probably over 10,000 electric motors in America to-day, of some fifteen different makes—Brush, Thomson, C. & C., Cleveland, Baxter, Van Depoele, Daft, Edgerton, Sprague, Hawkeye, Bergmann, Griscom, etc. Of one of these motors alone, over 30 types are now being built to fill orders and carry in stock—a point of no small importance as illustrating the remarkable commercial development of this latest electrical application.—*Electrical World.*

FOR making hair oil that is not injurious to the hair: Castor oil, ½ pint; 95 per cent alcohol, ½ pint; tincture cantharides, ½ ounce; oil of bergamot, 2 drachms. Color the mixture a pale pink with alkanet root.

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ENGINEERING INVENTIONS.

A car coupling has been patented by Messrs. Jacob W. Baker and George A. Prescott, of Dover, N. J. Combined with the drawhead and coupling pin is a movable toothed circular stop, adapted to support the pin when raised, and provided with pivots or bearings for operation in relation with the coupling pin and link.

A car coupling has been patented by Mr. George W. Wilson, of Lanesborough, Minn. This invention covers novel features of construction and the combination of parts in a device by which cars may be coupled automatically as they come together, without requiring the train men to stand between the cars, while it is simple and inexpensive.

AGRICULTURAL INVENTIONS.

A check rower for corn planters has been patented by Mr. Alvin Devine, of Rantoul, Ill. This invention provides a planter that is operated from a wire or rope stretched at the side, wherein the wire need not be detached at the ends when the planter is reversed, while the operating mechanism is strong and simple and not liable to lose motion by slight wear.

A harrow has been patented by Mr. Elihu P. Stone, of Lincoln, Kansas. It has a transverse shaft with crank arms at its ends mounted on the harrow frame, with means for turning the shaft to raise or lower the harrow frame, with various other novel details and combinations of parts, whereby the teeth of the harrow may be raised out of the ground and cleaned.

A cultivator has been patented by Mr. Wilbur F. Hubbell, of Wauseon, Ohio. It has a tubular plow beam, preferably formed of iron pipe, with a socket forged on its forward end and connected with an upwardly bent arm, making a beam and standard which will support a number of plows, and which may be readily adjusted to place the plows at different distances from each other.

MISCELLANEOUS INVENTIONS.

A hoisting machine has been patented by Mr. Patrick Connolly, of Scranton, Pa. The invention covers a machine of novel construction intended principally for use in mines for putting roof timbers and props or struts in place.

A bill or paper file has been patented by Mr. Frank B. Gilbert, of Jefferson, Texas. The invention consists in a file having a recess or slot formed near its piercing end and a tongue pivoted therein, to prevent the bills or papers on the file from working off.

A spokeshave has been patented by Mr. James H. Polhemus, of Brooklyn, N. Y. This invention covers a novel construction and combination of parts in a spokeshave designed to be capable of use as readily in curves of small radius as upon a flat surface, or in apertures large enough to admit the tool.

A wagon jack has been patented by Mr. Nathan L. Hakes, of Grafton, N. Y. The invention covers novel features of construction and combination of parts, whereby there is no tendency to swing the load lifted by the jack, strain on the jack and vehicle being thereby reduced to a minimum, while but little power is required to work the jack.

A windmill has been patented by Mr. Martin V. Harper, of North Yakima, Washington Ter. It has a pivoted vane, presenting more or less surface to the wind, so that when the latter changes to a storm it assists in changing the face of the wind wheel from the direction of the storm, with other novel features, intended to make a simple, durable, and efficient windmill.

A spring bed bottom has been patented by Messrs. Frank W. Smith and George D. Livingston, of Dodge Center, Minn. A cover is stretched over the springs and folded at its corners, hooks held in the corners of the frame being passed through the folded corners of the cover, whereby the latter is drawn taut and held from displacement, while it can be readily applied and easily detached.

A hame tug buckle has been patented by Mr. Charles Rozell, of Great Bend, Kansas. It is cast in one piece and in box form, with a central passage for the trace and two side passages for the back pad billet, to the lower end of which the belly band of the harness may be buckled, thus effecting a saving in stock and in the labor of attaching a separate billet to the side buckle.

A machine for jointing and shaping shingles has been patented by Mr. Alfred T. Stimson, of Eureka, Cal. It is designed to take the shingles as they leave the shingle saw, bunch them radially in the machine, ornament the ends of the shingles according to a pattern to be detachably clamped or bolted to an arm of the machine, and simultaneously joint their upper longitudinal edge.

A fastener for the meeting rails of sashes has been patented by Mr. John F. Pool, of Mount Carmel, Ill. The fastener consists of a catch mounted within a case, the catch being supported by a pivot pin which carries a forwardly extending spring resting in an aperture formed in the catch, whereby the sash may be held in closed position or may be held partially open.

A repeating watch has been patented by Ami F. Pfister, of Locle, Switzerland. The invention consists principally in a device for obstructing the hammers for a constant interval between the strokes of the hour and the quarter, the quarter and the minute, etc., and in novel means for disengaging the winding mechanism when the repeater is to be used, the arrangement of the gongs and the striking mechanism under the dial, with various novel details and combinations of parts, the repeating mechanism not encroaching upon the movement.

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We do not condemn the theory or the practice of resorting to fresh air mountain retreats, quiet country homes, seaside rambles and bathing, or the various mineral springs as restoratives to failing health. No doubt there are many who have been greatly relieved by all these favorite resorts, and some very justly claim they have been cured. But the number is legion that find no comfort, no relief to their weakness, their aches, their pains, in such grasping at straws in their struggle to save themselves. The following letters illustrate this point, and show the wisdom of the one most interested in the case.

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TABLE OF CONTENTS.

1. Elegant Plate in Colors of a Four Thousand Dollar Residence at Flushing, N. Y., with floor plans, specifications, sheet of details, bills of estimate, etc.
2. Plate in Colors of a Twelve Hundred Dollar Double House, with plans, specifications, sheet of details, bills of estimate, etc.
3. Page engraving of an Elegant Residence corner Eighth Avenue and Berkeley Street, Brooklyn, N. Y.
4. The new United States Court House and Post Office, Montpelier, Vermont. Half page engraving.
5. Half page engraving showing Competitive Design for Carnegie Free Library, Allegheny City, Pa., Jas. W. McLaughlin, Architect.
6. The National Agricultural Exposition Building at Kansas City. Quarter page engraving.
7. Drawing in perspective, with floor plans, of a Forty-five Hundred Dollar Dwelling.
8. Engraving of the Cogswell Polytechnic College, San Francisco, with description.
9. Illustrations of an English Double Cottage of moderate cost.
10. Design for a Marble Fireplace. Half page illustration.
11. Perspective view, with floor plans, of a Handsome Cottage of moderate cost.
12. Design for a Church of moderate cost. Half page illustration.
13. Two elevations and a floor plan of an Austrian Country House.
14. Engraving of Tomb of Colonel Herbinger, Mont Parnasse Cemetery, Paris.
15. Selections of Carved Work from the New Hotel De Ville, Paris. Page of illustrations.
16. Two large views of Engine Room at Ferguslie Mills, Paisley: Decoration in Burmantofts Faience.
17. A French Villa at Enghien-les-Bains, France. Two perspective views and four figures showing floor plans.
18. The College of the City of New York: The Technical Courses. Eleven views of different Departments.
19. Perspective view of City Residence of Herr Windesheim, at Halle, Germany.
20. The Home of Milton. Full page of views.
21. Quarter page engraving of a Continental Cottage.
22. Miscellaneous Contents: Useful Items for Builders.—A Woodpecker's Sugar Bush.—Preservation of Woodwork.—Sand in Plaster.—One Safe Theater.—A Portable Scaffolding, illustrated.—How to Increase your Wages.—Good Water Promotes Good Health.—Etruscan Tombs.—Floors and Ceilings, Ancient and Modern. By C. Powell Karr, C.E., Consulting Architect. Three illustrations.—Apparatus for Testing Lime and Cements, two figures.—Whitewash as a Fire Extinguisher.—Why Pipes Burst.—How Lamp Chimneys are Made.—The Largest Vase in the World.—Description of an English Laundry.—Mud Architecture in Persia.—How Window Glass is Made.—Use of Basswood.—Painted Plate Glass Mirrors.—Flour Adulterations.—Cubic Contents of the Chinese Wall.—A Waterproofing Process for Stone.—Paper Car Wheels, how Made.—Blistering of Paint and Varnish.—Artificial Asphalt.—Staining and Finishing Common Woods.—Plumber's Trap, illustrated.—Improved Bevel, illustrated.—Naval Architecture during the Last Half Century.—Best Effects in Paper Bedroom Decoration.—Planting of Trees and Shrubs.—"Hydrofuge" Floors, illustrated.—Laddering a Tall Chimney.—Adamant Wall Plaster.—Temporary Bridges, with illustrations.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

August 9, 1887,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid, manufacture of carbonic, C. Arnois 368,123
Advertising device, E. E. Alderman 367,946
Alarm. See Burglar alarm. Till alarm.
Ammonia in ammonia motors, etc., apparatus for recovering, P. J. McMahon 367,993
Ammonia, preparing anhydrous, P. J. McMahon 367,992
Annunciator, electrical, Poole & Schnepf 367,925
Auger, earth, J. H. Stowe 368,172
Axles, device for cutting vehicle, O. Whitmore 368,178
Axles, process of and apparatus for toughening steel, J. Coffin 367,961
Bag. See Base bag. Clothes pin bag.
Bag holder, F. Pease 368,109
Bag holder, H. Schneck 368,015
Baling press, T. J. Corning 368,074
Baling press, W. W. Seeley 367,982
Baling press, S. W. Trabue 367,968
Barrel swing and support, Ford & Waters 367,802
Base bag, J. L. Brown 367,889
Basin stopper, wash, F. R. Johnson 367,814
Battery. See Primary battery.
Beam connection, Sims & Morris 368,019
Bed bottom, spring, Smith & Livingston 368,023
Beehive, F. F. Eckhardt 368,078
Belt and pocket, combined, S. Nathan 367,996
Belt replacer, W. B. Knight 368,094
Belt shifter, J. Canning 367,891
Belt shifter, C. Ross, Jr 368,009
Belt shifter, oiler, and shaft cleaner, compound, J. W. Erskine 367,900
Belting, manchinery for the manufacture of rubber, Plamondon & Palmer 368,166
Bent tube, A. Taplin (r) 10,859
Beverages, purifying and preserving, Somps & Weise 367,988
Bicycle, Yost & McCune 367,883
Binding post, P. J. Higgins 368,149
Block. See Tackle block.
Boat, N. S. & E. R. Bowdish 368,058
Boiler. See Steam boiler.
Boiler, M. Mahony 367,988
Boiler cleaner, W. Kert 367,915
Bolt, A. W. McIntyre 367,827
Book, pocket check, C. R. Smead 368,020
Boot or shoe soles, device for inking the edges of, W. W. Crooker 367,895
Boot or shoe soles, machine for beating out, J. Pray 367,927
Boot or shoe strap, J. L. Rousmaniere 368,850
Boot or shoe uppers, mechanism for cleaning, L. B. & F. B. Newhall 368,105
Bottle stopper, M. O. Rhefuss 368,113
Box. See Miter box. Pill box.
Box, A. S. Nichols 367,886
Box board caps, device for cutting, J. Weber 367,875
Box fastening, card board, S. Geiger 367,970
Box strap, J. K. Chase 367,892
Bracket. See Dental engine bracket.
Brake. See Car brake.
Brake, H. Dewey 367,765
Broom corn, machine for cutting, G. E. Burkholder 367,957
Brush handle attachment, G. J. Cline 368,070
Buckle, hame tug, C. Rozell 368,011
Buckle, suspender, D. L. Smith 368,022
Bung and bushing, O. Eisenhuth 368,139
Burglar alarm, S. T. Lamb 368,095
Burner. See Gas burner. Lamp burner. Hydrocarbon burner.
Bustle, H. P. Olmstead 368,106
Bustle, H. Payne 368,000
Butter, purifying and preserving, G. W. Towar, Jr 367,940
Button attaching machine, W. O. Crain 368,134
Buttonholes, making, J. D. Wentworth 368,035
Button or stud, T. I. Smith 367,860
Button setting machine, L. C. Emerson 368,141
Buttons to materials, securing, W. E. Bennett 368,124
Buttoner, glove or shoe, J. B. Smith 368,024
Cable hanger, F. E. Degenhardt 368,136
Camp kit, N. Jensen 367,812
Can machine, tin, Hazen & Merrill 367,978
Car brake, A. Argo 367,947
Car brake, C. E. Garey 367,805
Car brake, autematic, J. Y. Davis 367,791
Car coupling, Baker & Prescott 367,948
Car coupling, N. Edwards 367,798
Car coupling, C. H. Knowlton 368,155
Car coupling, W. A. Macomb 367,819
Car coupling, G. W. Wilson 367,944
Car door fastener and spark arrester, box, H. C. Lynch (r) 10,855
Car, dumping, G. F. Whitman 368,038
Car, railway passenger, L. C. Hyde 367,811
Car replacer, J. L. Dwight 367,967
Car, sleeping, J. W. Post 368,005
Car ventilation, J. M. Waggoner 368,040
Car ventilator, railway, F. Hanson 368,148
Cars, sealing attachment for freight, J. Jordan 368,152
Carboy carrier and stand, L. Hillebrand 367,980
Carburetor for air or gas, C. B. Dudley 368,137
Carding machine, S. D. Keene 367,914
Carding machine, A. F. Schmid 367,553
Carriage, child's, J. W. Savene 367,935
Carrier. See Carboy carrier. Cash and package carrier. Cash carrier.
Cart, road, J. H. Shufelt 367,854
Case. See Filing case. Toilet case.
Cash and package carrier, Bostedo & Thomas 367,951
Cash and package carrier, H. M. Weaver 367,874
Cash carrier, H. Thomas 368,029
Cask or barrel, I. H. Spelman 368,026
Caster, furniture, O. Pederson 368,110
Casting brass, mould for, W. Adams 367,774
Chain and pen and pencil holder, coombination watch, N. Frere 367,804
Check hook, J. B. Higgins 367,810
Chopper. See Cotton chopper.
Churn, A. M. Dunn 367,797
Cigar bunching machine, E. A. Kitzmiller 367,916
Cigar bunching machine, Kitzmiller & Culley 367,917
Cigar perforator, L. W. Fairchild 367,800
Cigars, forming long fillings for, O. Hammerstein 367,906
Clamp, F. J. Moser 368,104
Cleaner. See Boiler cleaner. Cotton cleaner. Flue cleaner.
Clip. See Hame clip.
Clock, magnetic, D. Drawbaugh 367,898
Clock system, electric, C. L. Clarke 367,960
Clothes drier, D. C. Westfall 368,036
Clothes pin bag, W. Jamieson 368,091
Clutch, friction, G. A. Slayton 367,856
Cock, stop, A. Convert 368,073
Coffee pot, J. Boudinot 367,780
Coffin handle, H. W. Morgan (r) 10,856
Collar, horse, J. Bolesky 367,950
Cotton chopper, G. W. Featherston 368,082
Cotton cleaner and condenser, D. Hess 368,087
Coupling. See Car coupling. Electric coupling. Sleigh coupling. Thill coupling.
Coupling hook, J. D. Gawn 367,969
Creel, Hanson & Nourse 367,908
Cuff holder, S. B. Ellithorp 368,081
Cultivator, W. K. Hoagland 367,913
Cultivator, W. F. Hubbell 367,982
Cultivator, J. H. Moore 368,158
Cutlery or similar articles, manufacture of, H. A. Brognard 368,061
Cutlery, etc., manufacture of, H. A. Brognard 368,060
Cutter. See Meat cutter.
Damper for furnace and other regulators, C. L. Ridgway 367,847

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Dental engine bracket, W. A. Knowles..... 368,154
Dental matrix, W. A. Woodward..... 368,042
Desk attachment, F. H. Cutler..... 367,789
Digger. See Road digger. Stubble digger.
Divider, G. Grimble..... 368,086
Door, cell, and window, prison, J. W. Mullins..... 367,832
Door hanger, J. L. Parks..... 367,998
Drawers, etc., construction of nests of, T. F. S. Tinne..... 368,173
Drier. See Clothes drier.
Drill. See Ratchet drill.
Drill blank guide, J. D. Cox, Jr..... 367,894
Dust collector, J. S. Smith..... 367,853
Electric coupling, C. Runels..... 367,931
Electric currents, arrester for, J. P. Freeman..... 367,901
Electric generators, commutator for, O. B. Shallenberger..... 367,984
Electric machines, coupling dynamo, E. Thomson..... 367,866
Electric machines, inclosing case for, C. H. Hinds..... 368,088
Electrodes, binding clamp for battery, H. J. Brewer..... 367,956
Elevators, pneumating valve operating mechanism for hydraulic, W. De Brock..... 367,794
Emery wheels, dresser for, W. W. Brisben..... 363,062
Engine. See Gas and oil engine. Pendulum or vibrating piston engine. Traction engine.
Engine attachment, J. S. Brown..... 367,784
Eraser holder, O. Mussinan, Jr..... 368,159
Exercising machine, R. Reach..... 368,111
Eyeleting machine, L. C. Emerson..... 368,140
Fan or blower, T. E. Knauss..... 363,093
Fare register, W. J. Rigney..... 367,930
Faucet, bung, W. H. Parham..... 367,999
Feed water heater, Grassmann & Cheek..... 368,147
Feed water heater, W. L. Oakes..... 367,839
Fence. J. Mahon..... 363,098
Fence post, J. D. Campbell..... 363,067
Fence post, E. Robards..... 367,848
Fence strip, barbed, J. Schmidt..... 368,014
Fences, warning strip for wire, W. J. Cloud..... 367,893
Fermentation, lactic, C. N. Waite..... 368,032
File, O. W. Loeffler..... 363,097
File, bill or paper, F. B. Gilbert..... 367,971
File for papers, etc., J. Chase..... 367,959
Filing case, graduated, R. M. Hodge..... 367,981
Firearm, revolving, J. M. Marlin..... 367,826, 367,821
Fire escape, J. Diss..... 368,075
Fire escape, O. Hansen..... 367,907
Fire escape, telescopic, E. H. Bayley..... 367,779
Fire extinguisher, J. T. Greenwood, Jr..... 368,085
Flour packer, G. Y. Smith..... 367,857
Flue cleaner, boiler, F. L. McGahan..... 367,826
Folding table, J. T. Bon..... 368,055
Frame. See Grindstone frame.
Funnel, C. Rehn..... 368,007
Furnaces, automatic stock indicator for, A. E. Brown..... 363,064
Furnaces, water jack for smelting, W. J. Godfrey. 367,904
Game, E. K. McGill..... 367,991
Gas and oil engine, combined, T. Shaw..... 367,937
Gas burner, natural, C. M. Young..... 367,945
Gas, engines, hydrocarbon and gas impluse feeder for, T. Shaw..... 367,936
Gas generator, oil, A. F. Randall..... 367,844
Gas lighting system, electric, Perkins & Hurley... 367,841
Gas regulator, A. Ford..... 367,801
Gas supply pipes, cut-off for, A. Reese..... 368,168
Gates, stop for double, M. Postlethwaite..... 367,926
Gear mechanism, W. Hanson..... 367,909
Generator. See Gas generator.
Governor, steam engine, E. J. Armstrong..... 368,044
Grain meter, H. R. Albrecht..... 367,775
Grate for fireplaces, fire, H. G. & W. R. Dawson.. 367,793
Grindstone frame, S. Lewis..... 368,156
Gun, machine, H. S. Maxim..... 367,825
Gun, magazine, H. Carr..... 368,130
Halter, R. T. Moss..... 367,831
Halter, R. D. Whittemore..... 367,943
Hame clip, P. W. Corcoran..... 367,787
Hand protector for ball players, E. Redmond..... 368,112
Handle, W. H. Berger..... 368,053
Hanger. See Cable hanger. Door hanger.
Harrow, E. P. Stone..... 368,118
Harrow and cultivator, tooth fastening, F. Wilcox..... 368,039
Harrow attachment, F. P. Sherwood..... 363,018
Harrow or cultivator tooth, G. Reid..... 367,845
Harrow, spring tooth, G. W. Gorsuch..... 368,146
Harvesting machines, compressor for, C. H. Salzman..... 367,852
Hat stretcher, T. S. Carroll..... 368,063
Hatchway, elevator, W. C. Freck..... 368,145
Heater. See Feed water heater. Vehicle heater.
Heater and feeder, O. Rothrock..... 368,170
Heating apparatus, J. Kohler..... 368,153
Heel plate or guard, W. E. Wrighton..... 368,120
Heels, attaching, F. F. Raymond, 2d..... 363,006
Hoe, wheel, C. E. Nash..... 367,835
Hoisting and dropping apparatus, H. S. Gail..... 367,903
Hoisting machine, P. Connolly..... 367,862
Hoisting machines, carriage for, A. E. Brown..... 363,065
Holder. See Bag holder. Cuff holder. Eraser holder. Package holder. Pencil holder. Sash holder. Whetstone holder.
Hook. See Check hook. Coupling hook. Whiffletree hook.
Hose together, apparatus for securing lengths of flexible, C. Darrah, Jr..... 367,790
Hydrocarbon burner, J. Schweizer..... 368,171
Ice cream freezer, A. Hooper..... 368,150
Indicator. See Station indicator.
Ingots, forming metal, E. Wheeler..... 368,176
Jack. See Lifting jack. Wagon jack.
Jewelry, C. W. Hartmann..... 367,976
Joint. See Pipe joint.
Key ring, N. W. Crandall..... 368,135
Ladder, W. R. Davis, Jr..... 367,792
Lamp burner, F. D. Kimber..... 367,817
Lamp, parlor extension, D. W. Parker..... 367,840
Lamp, regenerative gas, C. E. Bell..... 367,949
Lard, fruit, and oil press, M. Thompson..... 367,865
Last block fastener, G. A. Von Sholly..... 367,870
Lathe, C. Smith..... 368,021
Leather finishing machine, A. M. Bowers..... 367,952
Leather or other materials, machine for cutting, H. Parsons..... 368,108
Ledger and blotter, combined petit, H. A. Pershing..... 367,924
Leveling instrument, J. S. Smith..... 367,859
Lifting jack, M. H. Levy..... 368,096
Lifting jack, J. B. Winn..... 367,881
Liquid separator, centrifugal, C. A. Backstrom, 367,778, 368,045 to 368,049
Lock. See Nut lock.
Lock, B. Delvalle..... 367,963
Lock caps, machine for making, G. B. Cowles..... 368,133
Looms, positive shuttle motion for, B Northup... 367,888
Looms, stop mechanism for, D. Whelan..... 368,177
Looms, warp beam for, H. Wyman..... 368,122
Mashing, apparatus for, Doelfel & Hupfel..... 368,076
Match safe and candlestick, N. Jensen..... 367,813
Measuring the weight of loads, A. E. Brown..... 368,063
Meat cutter, O. D. Woodruff..... 368,041
Mechanical movement, J. S. Brown..... 367,888
Mechanical movement, R. E. Feldges..... 368,083
Metal shears, J. Riber..... 367,846
Meter. See Grain meter.
Milling machine, A. H. Brainard..... 367,954
Miner's tool for breaking down coal, J. Haag..... 367,807
Miter box, J. W. Rochford..... 367,849
Motor. See Water motor.
Musical instrument, mechanical, F. E. P. Ehrlich. 368,080
Musical instruments, pneumatic action for, W. D. Parker..... 363,164, 368,165
Nail machines, cutting die for wire, R. Berchtold..... 368,125
Naphthazarin, manufacture of soluble, R. Bohn.. 368,054
Net, fly, H. F. Walter..... 368,034
Nets, folding hoop for landing, J. Reed..... 367,928
Nut lock, G. & H. Heiler..... 367,809
Octave coupler, L. K. Fuller..... 367,902
Ordnance, apparatus for adjusting and retaining the sights for, H. W. Jones..... 367,815
Ore separator, E. A. Wall..... 368,033
Package holder, C. W. Dudley..... 368,138
Packing device for piston rods, H. S. Gaskill..... 367,806
Packing, piston, J. W. Walters..... 367,873
Pad. See Saddle pad.
Padlock, O. J. Meinhard..... 367,829
Paint press, J. W. & A. Kent..... 367,816
Paper machine, paraffine, D. A. Andrews..... 367,886
Paper, wire cloth to be used in the manufacture of, J. B. S. Maltby..... 367,990
Pencil holder, O. Mussinan, Jr..... 368,160
Pendulum or vibrating piston engine, J. W. Walters..... 367,872
Photographic camera shutter, W. H. Lewis..... 367,986
Piano, xylo-metalliphone, M. Braun..... 367,955
Picture and frame, relief, J. W. Ecker..... 367,899
Pill box, T. C. Waite..... 367,941
Pillow, A. G. Roenigk..... 368,111
Pipe joint, R. M. Reilly..... 367,929
Pipe wrench, E. O. Carvin..... 367,786
Pipes or rods, machine for cutting, A. Saunders.. 363,012
Pitman, B. P. White..... 367,942
Planter check rower, corn, A. Devine..... 367,964
Planter, corn, M. T. Broady..... 367,781
Planter, potato, F. M. Burger..... 368,129
Planters, attachment for corn, H. Wagner..... 363,031
Plates, shaving machine for curved, G. E. Lloyd.. 367,987
Plows, slip nose attachment for, C. Anderson..... 363,043
Pocket stay and holder, B. E. Tilden..... 367,939
Post. See Binding post. Fence post.
Pot. See Coffee pot.
Press. See Baling press. Lard, fruit, and oil press. Paint press. Screw press. Tablet press.
Press, F. Meschini..... 363,103
Press for packing bran, C. H. Browne..... 368,127
Presses, rack for wine or cider, R. E. Boschert..... 363,056
Primary battery, S. W. Maquay..... 368,099
Printing machine, cylinder, B. F. De Costa *et al*... 367,795
Printing presses, positive bridge action for platen, J. Thomson..... 367,867
Protector. See Hand protector.
Pruning shears, G. R. Pierce..... 367,843
Pulley, Lathrop & Tyrrell..... 367,784
Pump, J. H. Frenier..... 367,808
Pump, J. Schrankel..... 368,016
Pump, centrifugal, E. J. Hawley..... 367,911
Pump, centrifugal, I. P. Lambing..... 367,919
Pump system, centrifugal, I. P. Lambing..... 367,918
Puzzle ring, W. H. A. Davidson..... 367,896
Railway chairs, die for making, E. B. Entwisle.... 363,142
Railway, elevated, R. M. Beatty..... 367,887
Railway rail splice, D. E. Shea..... 363,017
Railway rails, apparatus for facilitating the cooling of, J. Coffin..... 368,132
Railway signal, I. H. Brown..... 368,066
Railway switch, W. D. Woodward..... 367,882
Railway switch, suspended, Potter & McDougall.. 367,842
Ratchet drill, J. Noble..... 363,162
Register. See Fare register.
Regulator. See Gas regulator.
Ring. See Key ring. Puzzle ring.
Rings or chain links, manufacture of, W. A. Peck. 367,923
Road digger and scraper, A. Finks..... 367,968
Rolling rods, etc., rolls for, H. A. Williams..... 367,879
Rolls, M. Sellers..... 367,933
Rubber, composition for cementing, H. Vogley... 363,174
Rudder, jury, J. Wall..... 367,871
Sack tie, M. F. Carr..... 367,785
Saddle pad, harness, C. W. Rogers..... 363,115
Salter, stock, E. J. Nichols..... 368,161
Sash fastener, J. F. Pool..... 368,004
Sash holder, G. B. Rowlett..... 363,010
Sawing machine, A. W. Carter..... 367,953
Sawing machine, circular, J. R. Strickland..... 367,864
Scales, automatic grain, E. N. Williamson..... 367,880
Screw press, R. E. Boschert..... 368,057
Scrubbing machine, J. N. Batts..... 368,052
Seal, baggage, J. W. Bryan..... 368,128
Seal, metallic, E. J. Brooks..... 363,126
Seal, self-fastening, Whaley & Forest..... 367,877
Separator. See Liquid separator. Ore separator.
Sewage, process of and apparatus for treating, L. Coes..... 368,071
Sewing machines, cutting mechanism for buttonhole, J. Douglas..... 367,796
Sewing machines, spool holder for, L. H. Goodwin..... 367,972
Sewing machines, starting attachment for, D. B. Haselton..... 367,910
Sewing or other machines, stand for, W. A. Mack 367,920
Shears. See Metal shears. Pruning shears.
Shingles, machine for jointing and shaping, A. T. Stimson..... 368,117
Ship building, J. McIntyre..... 367,828
Shovel. See Snow shovel.
Shovel and hoe, combined, A. Schad..... 368,018
Shovel blanks, machine for splitting the tangs and shaping the bodies of, H. M. Myers..... 367,884
Shovel blanks, machine for spliting the tangs of, H. M. Myers..... 367,883
Signal. See Railway signal.
Singletree, G. K. Edgley..... 368,079
Sleigh coupling, C. Harrigan..... 367,908
Slotting or drilling machine, convertible, F. H. Brown..... 367,782
Snow excavator and automatic dumper, G. E. Nichols..... 367,837
Snow shovel, J. R. McLaren, Jr..... 363,102
Sole laying machine, Clark & Stone..... 363,131
Sole laying machine, W. R. Goodwin..... 367,905
Sower, broadcast seed, W. L. Miller..... 367,880
Spinning spindles, support for, W. T. Carroll..... 368,069
Spokeshave, J. H. Polhemus..... 368,003
Spring. See Watch case spring.
Stairway, F. O. Hanson..... 367,974
Stand. See Switch stand.
Station indicator, T. D. Smith..... 367,861
Stave crozing machine, J. W. Callahan..... 367,890
Steam boiler, M. Kirwan..... 367,983
Steam boiler, W. B. Le Van..... 367,818
Steam trap, McDougall & Sugden..... 368,101
Steam trap, J. J. Royle..... 367,851
Stool and sewing machine cover, combined, H. C. Robertson..... 368,008
Stopper. See Basin stopper. Bottle stopper.
Store service ways, support for, H. Thomas..... 368,028
Stove cover and lifter, F. M. Collins..... 368,072
Stove, heating, D. J. Rogers..... 368,116
Stove, open grate, C. A. Wellington..... 367,876
Stove or furnace, heating, E. W. Anthony..... 367,777
Stovepipe thimble, H. E. Anderson..... 367,885
Stoves or ranges, heat diffuser for, J. H. Wilkinson..... 367,878
Strainer, milk, R. L. Anderson..... 367,776
Strap. See Boot or shoe strap. Box strap.
Straw stacker, J. L. Whitfield..... 368,037
Stubble digger and cultivator, J. Mallon..... 367,989
Surgical water bandage, H. W. & J. Sitwell..... 367,855
Swing, portable, F. H. Cutler..... 367,788
Switch. See Railway switch.
Switch stand, E. J. Remillon..... 368,169
Switch stand, F. W. Snow..... 367,862
Table. See Folding table.
Tablet press, M. F. Doud..... 367,897
Tackle block, metal, G. A. Ford..... 368,144
Thermometer scale, G. B. St. John..... 367,863
Thermometer, metallic, E. W. Upton..... 367,869
Thill coupling, J. B. Fink..... 368,143
Thill coupling, W. H. Tibbits..... 368,119
Throstles or other spinning machines, register for, D. & F. H. Orme..... 368,163
Tie. See Sack tie.
Till alarm, L. Goodyear..... 368,084
Toe forming machine, box, J. F. Soule..... 363,025
Toilet case, A. C. Spencer..... 363,027
Traction engine, M. E. Hershey..... 367,912
Trap. See Steam trap.
Trunk, traveling, C. D. Hess..... 367,979
Truss, J. Y. Egan..... 367,799
Truss, abdominal, F. & T. H. Williams..... 368,040
Tube. See Bent tube.
Tubes, composite ingot for producing seamless, E. Wheeler..... 368,175
Tubes, die for forming bent, A. Taplin (r)..... 10,858
Tubes, manufacture of bent, A. Taplin (r)..... 10,857
Tubing, manufacture of, H. C. Bradeen..... 368,059
Umbrella or cane head, B. F. Du Bois..... 368,077
Uncoupling device, automatic, G. L. Lubbering... 368,157
Valve, automatic shut-off, J. G. Moomy..... 367,994
Vegetable slicer, M. L. Keach..... 368,092
Vehicle heater, E. A. Olmstead..... 367,997
Vehicle, two-wheeled, F. L. Perry..... 368,001
Vehicles, shifting seat for, C. C. Adelsperger..... 367,884
Velocipede, J. C. Powell..... 368,167
Ventilation of pillows, etc, W. H. Bowman..... 367,953
Ventilator. See Car ventilator.
Wagon jack, N. L. Hakes..... 367,973
Warp beam, H. Wyman..... 368,121
Warping machines, lifting wire for stop motions of, W. Bancroft..... 368,050
Watch case spring, G. A. McCay..... 368,100
Watch, repeating, A. P. Pfister..... 368,002
Watches, push button for repeating, C. Morlet.... 367,995
Water motor, F. A. Hinds..... 368,089, 368,090
Waterproof garment, H. C. Morton..... 367,921
Weather strip, C. H. James..... 368,151
Weighing and registering apparatus, grain, Lee & Downs..... 367,985
Well drilling and piping machine, J. S. Brown..... 367,783
Well packer, oil, B. Masseth..... 367,823
Wells, device for removing casing from oil, B. Masseth..... 367,822
Wells, drilling packer for oil, B. Masseth..... 367,824
Whetstone holder, D. Parker..... 368,107
Whiffletree hook, J. M. Basinger..... 368,051
Winding machinery, yarn, Nourse & Foss..... 367,922
Winding yarn, machine for, B. A. Dobson..... 367,963
Windmill, M. V. Harper..... 367,975
Wood bending bevice, C. D. Hazen..... 367,977
Wrench. See Pipe wrench.

DESIGNS.

Carpet, F. Allen..... 17,587, 17,588
Carpet, M. F. Beale..... 17,589 to 17,593
Carpet, E. Fisher..... 17,596 to 17,598
Carpet, J. L. Folsom..... 17,599 to 17,606, 17,622, 17,623
Carpet, E. H. Hill..... 17,609, 17,610
Carpet, T. E. Meagher..... 17,611, 17,612
Carpet, C. W. Swapp..... 17,617 to 17,620
Ox shoe, J. Deeble..... 17,595
Musical instrument case, T. Hill..... 17,625
Radiator, steam, H. Parmelee..... 17,614
Radiators, ornamentation of, Pierce & Bond..... 17,615
Scarf, A. Hellenber..... 17,608
Sheet metal, ornamentation of, J. Wood..... 17,621
Signs, letters for, R. F. Gillin..... 17,624
Statuette, R. T. Crane..... 17,594
Table, center, W. Niemann..... 17,613
Ticking or similar fabric, H. S. Kneedler..... 17,626
Type, font of printing, G. F. Giesecke..... 17,607
Watch case, F. Rapp..... 17,616

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Rubber clothing, articles of, Boston Rubber Company..... 14,674
Suppositories for curing female diseases, D. P. Stedman..... 14,670
Whetstones, A. F. Pike Manufacturing Company.. 14,676
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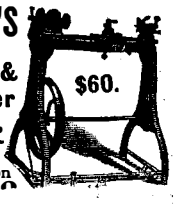

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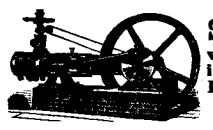

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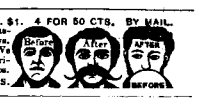

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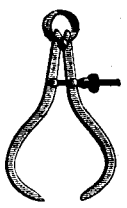

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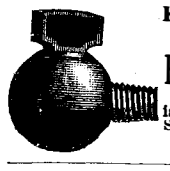

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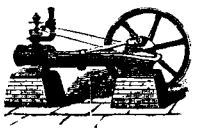

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Proposals for Steel-cast Guns for the Navy.
NAVY DEPARTMENT,
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Under authority conferred by the act of Congress, approved March 3, 1887, making an appropriation "for the purchase and completion of three steel-cast, rough-bored and turned, six-inch, high-power rifle cannon, of domestic manufacture, one of which shall be of Bessemer steel, one of open-hearth steel, and one of crucible steel," sealed proposals from domestic manufacturers, to furnish the same, will be received at this Department until Tuesday, the second day of August, 1887, at 12 o'clock noon, at which time the proposals will be opened.

Proposals may be made either to furnish three completely finished six-inch, breech-loading, high-power rifle cannon, made from unforged castings, one of Bessemer steel, one of open-hearth steel, and one of crucible steel, or three unforged, rough-bored and turned castings for such cannon, of the same material, respectively, to be finished by the Department in accordance with the bidder's design.

* * * * * * * *

No gun or casting for a gun will be paid for until the gun "shall have been completed and have successfully stood the statutory test required by the act of July twenty-sixth, eighteen hundred and eighty-six," entitled "an act making appropriations for the naval service for the fiscal year ending June thirtieth, eighteen hundred and eighty-seven, and for other purposes." [For statement of requirements of said tests, and of other conditions to be observed, reference is made to "specifications" which can be had upon application to the Department.]

Proposals may be made for one or more guns or for one or more castings as aforesaid, * * * [but must be made separately for each gun, or casting for a gun, and upon forms prepared by the Department.]

Each successful bidder will be required to execute within fifteen days after notice of award, a formal contract in accordance with his proposal, and to furnish a bond, with satisfactory sureties, in a penal sum equal to fifteen per cent. of the amount of his bid, conditioned for the faithful performance of such contract.

Copies of the specifications, with blank forms of proposals, and all additional information desired, can be obtained on application to the Bureau of Ordnance, Navy Department.

All proposals must be in duplicate, inclosed in envelopes marked "Proposals for Steel-cast Cannon," and addressed to the Secretary of the Navy, Navy Department, Washington, D. C.

The right is reserved to waive defects in form and to reject any or all bids.

WILLIAM C. WHITNEY,
Secretary of the Navy.

NAVY DEPARTMENT,
WASHINGTON, D. C., *July* 20, 1887.

In order to give more time to domestic manufacturers to consider the matter, the period limited for the reception of proposals for steel cast guns is hereby extended, and such proposals will be received, under the foregoing advertisement, as modified, until Tuesday, September 20, 1887, at 12 o'clock noon, at which time the proposals will be opened.

WILLIAM C. WHITNEY,
Secretary of the Navy.

Proposals for three Overhead Travelling Cranes complete, three Supports for such Cranes, and one Iron Frame for a Building.
NAVY DEPARTMENT,
WASHINGTON, D. C., *July* 23, 1887.

Sealed proposals will be received at the Navy Department, Washington, D. C., until 12 o'clock noon, on Thursday, the 15th day of September, 1887, at which time and place they will be opened in the presence of bidders, for furnishing the necessary material and labor and constructing, delivering and erecting the iron work for the supports of three overhead travelling cranes, the frame of one building, and three overhead travelling cranes complete, including attachments pertaining thereto, for the Ordnance Gun-shops at the Navy Yard, Washington, D. C., in accordance with plans which may be seen, and specifications, copies of which, together with all other information essential to bidders, may be obtained at the Office of the Civil Engineer at said Navy Yard. Proposals must be made in accordance with forms which will also be furnished on application to that Office.

Proposals must be made in duplicate and inclosed in envelopes marked "Proposals for Overhead Travelling Cranes complete, for Iron Supports for such Cranes, and Iron Frame for a Building," and addressed to the Secretary of the Navy, Navy Department, Washington, D. C.

The Secretary of the Navy reserves the right to reject any or all bids, as, in his judgment, the interests of the Government may require.

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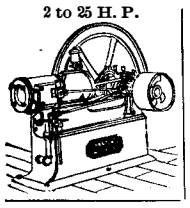

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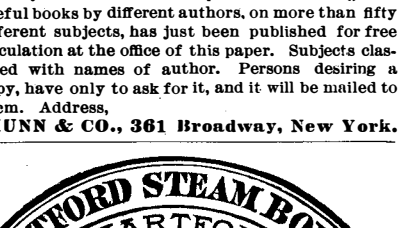

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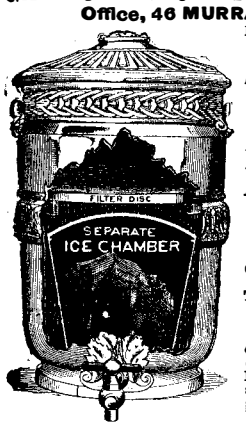

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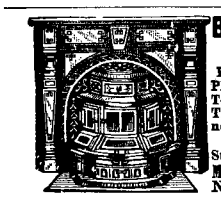

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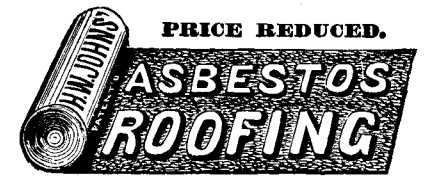

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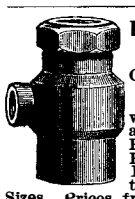

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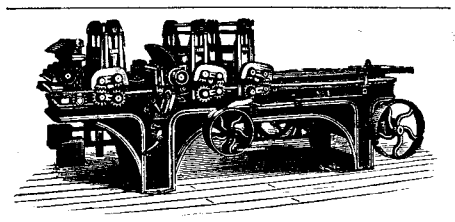

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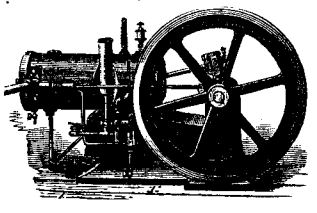

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